GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

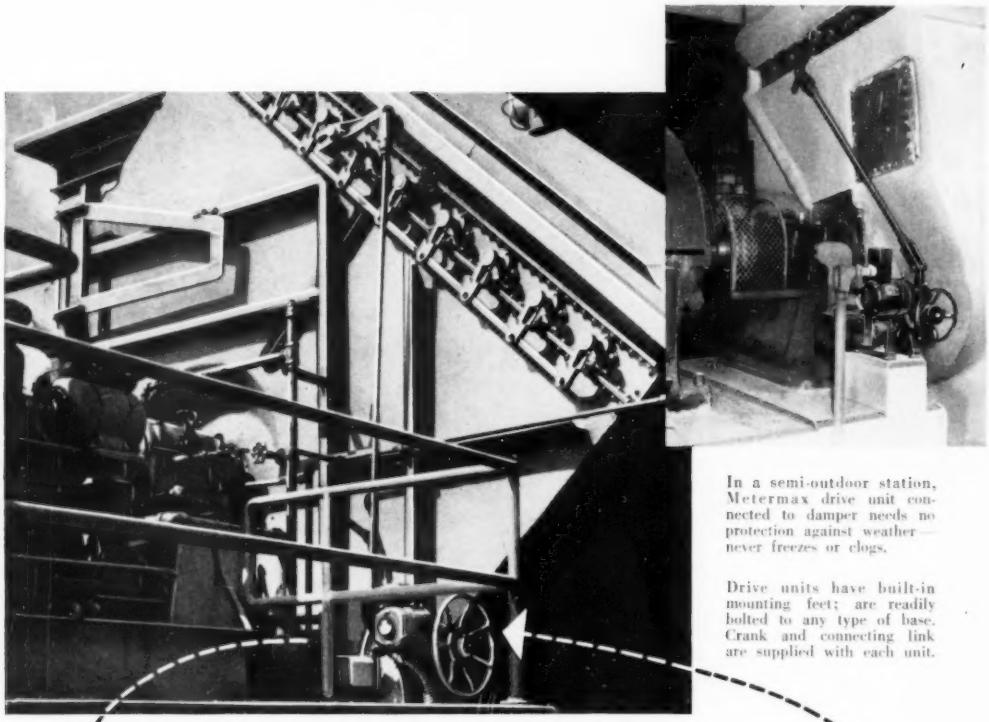
Power

A McGRAW-HILL PUBLICATION

July 1952 • 50¢

- **Building reliability into today's high-speed generator rotor — 82**

IN THIS ISSUE: 24-p practical manual on piston rings — 103



In a semi-outdoor station, Metermax drive unit connected to damper needs no protection against weather—never freezes or clogs.

Drive units have built-in mounting feet; are readily bolted to any type of base. Crank and connecting link are supplied with each unit.

electric muscles

FOR BETTER COMBUSTION CONTROL

● Take a close look at the parts of a combustion control system that do the actual moving of dampers, vanes and other controlled elements. They're important to the overall performance of the control. In the Metermax system, you'll find all these jobs done by electric drive mechanisms, selected for these outstanding features:

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True Position Indication: electric indicator on panel responds only to movement of drive shaft; no errors due to sticking of dampers.

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Our Folder NU9-463(1) gives full details about Metermax electric drive units. For a copy write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

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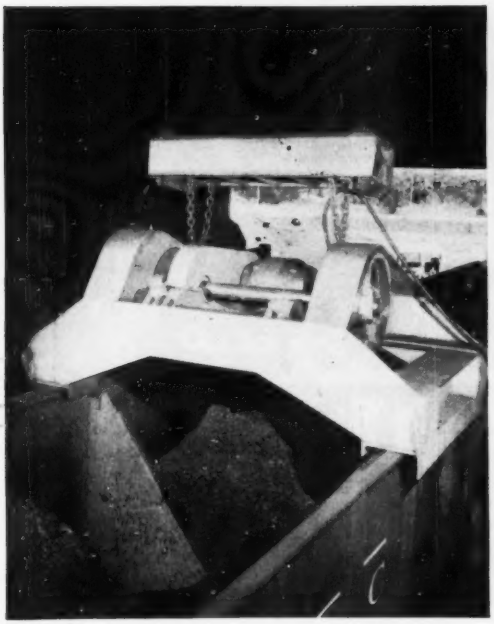
Jrl. Ad. NU 9-01-463(4a)

LINK-BELT Car Shakers and Rotary Dumpers
empty railroad cars faster...
...more gently...at lower cost



IT'S EASIER ON CARS... thanks to exclusive low-frequency vibration. And the Link-Belt Car Shaker also has a much lower noise level. Positive action gets most hopper bottom cars "broom-clean" in a few minutes. Especially good for damp, sticky materials. Write for Book 2345.

UNLOADS GONDOLAS IN 90 SECONDS or less (including return to upright position)! Simple, automatic, fool-proof—Link-Belt Rotary Car Dumper can be operated by unskilled labor. Takes all types of open top cars... up to 90-ton capacity.

Get an unbiased recommendation for the right type of car unloader for your needs

Whether you empty a few gondola cars a day or hundreds—Link-Belt has equipment designed to do the job with maximum efficiency. Shortages of manpower, demands for ever-increasing production—both emphasize the necessity for mechanized, push-button car unloading.

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LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,320

Simplicity, long life, easy maintenance

CAPACITIES TO 1000 GPM
PRESSURES TO 1200 PSI
TEMPERATURES TO 350-400F

1. Opposed impellers balance axial thrust.
2. Impeller mounting provides leak-proof shaft sealing between stages.
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6. Positive interstage wearing ring seals eliminate leakage.
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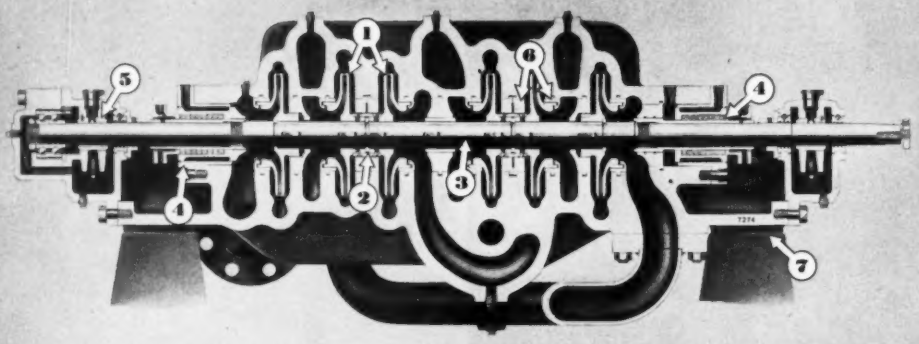

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OPPELLER PUMPS

Look at the seven outstanding features shown in the cross-section and you'll see why De Laval Boiler Feed Pumps stay on the job for years...trim maintenance costs. Suitable materials are available for all water conditions. Write today for bulletin giving full application and specification data.

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DE LAVAL STEAM TURBINE COMPANY
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DL 148

Power

JULY 1952 • VOLUME 96 NUMBER 7

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, which is available for 50¢ from the editorial offices.

GENERATOR ROTORS like the one on our cover come out of the shops these days in record-breaking numbers, to meet the needs of our tremendous power-building drive. Unit pictured is being checked in GE's Schenectady shops before shipment to California Electric Power Co. It's second of three machines, totaling 100,000 kw, for CEP's new steam plant at Highgrove.

Today's high-speed rotors are more reliable, and can be built more economically, because of steady progress in design and construction methods. For a quick summary of these developments, see p 82.

Next month . . .

■ New theories of energy processes, put forward by Prof Neil Bailey in March POWER (p 74) and at a meeting held at Rensselaer Poly, have created quite a stir. As of now the "great debate" still rages. See August for a quick roundup of comments, first step in our program of reporting the outcome of his proposals.

■ If you thought dc was "on the way out," you're wrong. Matter of fact, the business of rectifying ac to dc is on the upswing, as you'll see in a survey of current methods, including a new mechanical power rectifier.

■ Stuffing boxes do only as good a job as you let them. To keep them in tiptop shape, read Frank Cowan's practical tips on tools and maintenance methods.

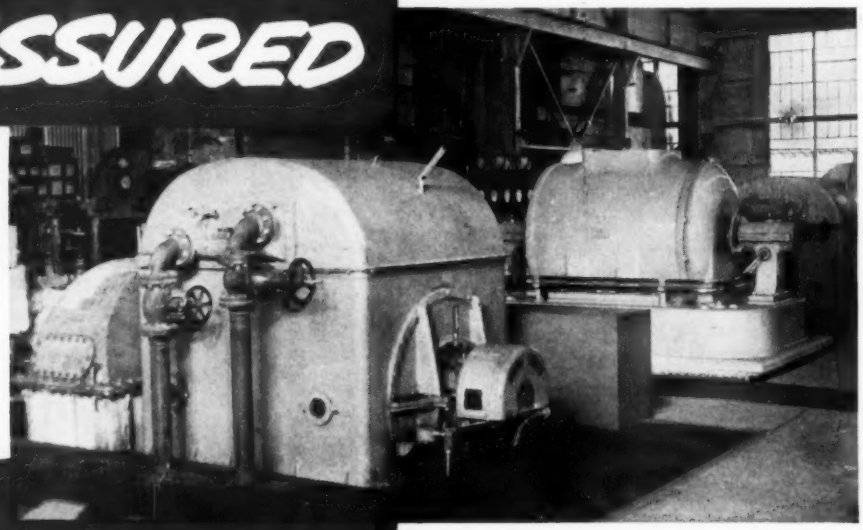
■ Whether you rewind your own motors or have the work done for you, you need to know the steps involved in a first-class job. An August picture story takes you, step by step, through the rewinding of a squirrel-cage induction motor. Future articles will cover other types.

. . . and future months

■ Biggest event of the POWER future still looks to be our 48-p "special" on water. With the help of Ladislav Sutnar, graphic arts consultant, we've planned a unique pictorialized presentation of the basic facts you need to understand this most important of industrial raw materials and to build a sound water program for your plant.

Dependable Performance ASSURED

TOWN OF GALLUP (N. M.) ELECTRIC POWER PLANT is 100% Texaco-lubricated. These two General Electric turbines — 4600 KW and 1800 KW — have been lubricated with *Texaco Regal Oil B (R & O)* ever since they went on the line.



BECAUSE—Texaco Regal Oil (R&O) keeps turbines rust-free, sludge-free, foam-free

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There is a complete line of *Texaco Regal Oils (R&O)* for every type and size of turbine. They meet the stringent specifications of all leading turbine builders and are the choice of operators everywhere.

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Power

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...with Power readers...

INFORMATION, PLEASE!

Some years ago, you published an article on a simple way to analyze short circuits in small electrical systems. Can you tell me when this article appeared and send me a reprint or a copy of the issue? I need the information and will greatly appreciate any help you can give me.

Los Angeles, Calif. D J CHAMBERS

Reader Chambers' request is typical of many we receive. We publish it here because it gives us a chance to tell all our readers something of our practices with respect to reprints, back issues and the like. It may save you time and trouble when you need information that has been published in POWER.

First as to back issues. For obvious physical reasons we can only keep a limited stock of back issues and those only for a short time—usually less than six months. Thus when you ask for older issues we must refer you to firms making a business of stocking and selling back-number magazines, of which there are several.

Most of the time, however, a complete issue isn't needed, only a particular article. We keep a stock of "tear sheets" and can usually supply copies of individual items up to about a year after publication. These may be obtained without charge as long as the supply holds out.

(*Continued on page* 206)

...lines and bylines

John Salviani

WORLDWIDE operations of Chemical Construction Corp take its engineers to many far corners, give them many interesting international insights. We asked John Salviani, who describes a Chemico project on pp 71-73, to tell us some of his impressions of engineering in out-of-the-way places.

Most surprising, he says, is what can be done by putting American know-how in partnership with native craftsmen and unskilled labor. This combination makes it possible to construct and operate complex modern chemical and power projects in spots where technical skills are unknown. He cites pipe welding as a field where native labor excels.

In some countries, a handful of American welding instructors have been able to train enough native welders to meet all job needs. And their work quickly proves good enough to handle not only high-pressure piping but tricky welding on stainless pipe and vessels.

M H Kuhner

BOILERS AND FURNACES have been Max Kuhner's prime professional interest ever since he graduated from the University of Karlsruhe in 1921. His career in power began then with development work on the first commercial 1500-psi natural-circulation unit.

In this country in 1925, Max took charge of engineering for Badenhausen Corp and held the post of chief mechanical engineer until the consolidation, in 1931, with Riley Stoker Corp. He then moved to Riley's Worcester headquarters as chief mechanical engineer for development of steam-generating and fuel-burning equipment. Since 1949, he has been vice-president in charge of engineering.

Last year Max took a swing through European boiler shops, was mightily impressed by their modern manufacturing methods, economical use of critical materials. And also by the serious study given American design advances as reported in the technical press.

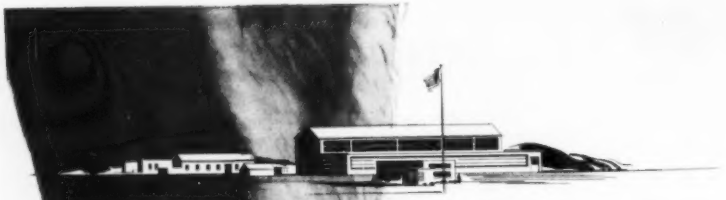
Max likes to recall that his university friends threw up their hands in horror when he said he was going into steam power. It was supposed to be on the way out. Now, 31 years later, he can't see any job more exciting than that of building better boilers. "Never a dull moment," he says, makes it a hobby as well as a career.

Steve Elonka

PISTON RINGS was the subject of one of Steve Elonka's early contributions to POWER. Based on his experience as machinist and marine engineer, it passed along shop-wise tips on installing and renewing rings.

As a POWER staffer, Steve has been itching for some time to start a series of practical manuals for engineers concerned with operation and maintenance. He got the green light a while back and took piston rings as subject for the first effort in this new direction.

For months now he's been up to his neck in piston rings—refreshing his own wealth of experience, digging out dope on new problems and new answers. The result begins on p 103. If you like it, why not drop Steve a line and tell him.



...arch and Development Come ...

modern trends in steam generation that are helping to ...ee... power

CUT IS

——down——

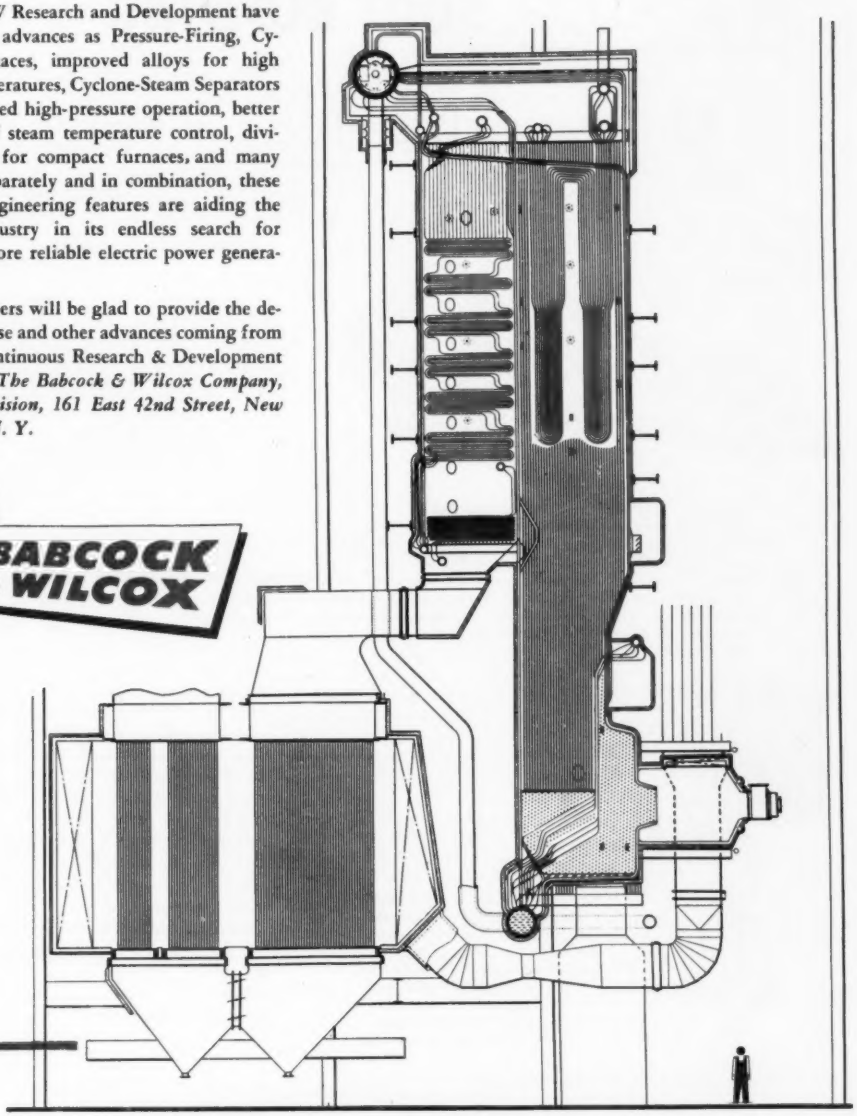
G-562T

In averaging 1.13 lb. of coal per kilowatt-hour during the past year, America's electric companies set a new record in their uninterrupted drive to hold down the cost of electric power generation. This continued, phenomenal, year-by-year record of progress has resulted from painstaking attention to the details of *all* equipment needed for the production of electricity. Of particular significance have been B&W developments in fuel-burning methods and steam generation. Many of these are included in today's most efficient stations having heat rates of less than 0.8 lb. of coal per kilowatt-hour.

From B&W Research and Development have come such advances as Pressure-Firing, Cyclone Furnaces, improved alloys for high steam temperatures, Cyclone-Steam Separators for simplified high-pressure operation, better methods of steam temperature control, division walls for compact furnaces, and many others. Separately and in combination, these modern engineering features are aiding the power industry in its endless search for cheaper, more reliable electric power generation.

Our engineers will be glad to provide the details on these and other advances coming from B&W's continuous Research & Development Program. *The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.*

BABCOCK & WILCOX



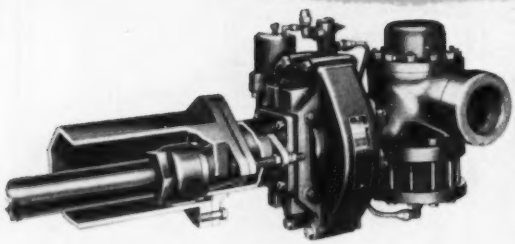
Pressure-Firing, Gas Recirculation, Cyclone Furnaces, High Pressure and Temperature with Reheat, and Cyclone Steam Separators are features of this B&W Radiant Boiler on order for a mid-west power company. Rated steam capacity—1,200,000 lb. per hr. Design pressure—2125 psi. Pressure at superheater outlet—1900 psi. Final steam temperature—1050F. Reheat to 1000F.

DIAMOND "AIR PUFF" SOOT BLOWING IS AUTOMATIC

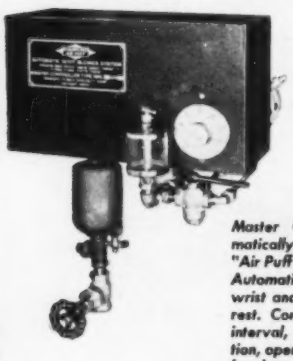
MOTORIZED
SELECTIVE
SEQUENTIAL

plus

SIMPLICITY
LOW COST



Diamond "Air Puff" Soot Blower has multi-nozzle element permanently installed inside setting. Compressed air is discharged in measured short puffs with pauses between. The air motor rotates the element during puff . . . stops during intervals while original air pressure is restored. Air waste avoided by confining blowing time to period when pressure is high enough to be effective.



Master Controller which automatically controls all Diamond "Air Puff" Soot Blowers in system. Automatic . . . just a twist of the wrist and the controller does the rest. Controls puff duration and interval, regulates element rotation, opens and closes air valve in head, and determines sequence.

The most effective and economical means for automatic cleaning of small and medium sized boilers is usually the Diamond "Air Puff" Soot Blower System. It is an automatic sequential system . . . the engineer merely actuates the control to start. The compact, versatile controller operates each blower correctly and in proper sequence . . . then shuts off at completion. The blowing air is used for all functions . . . blowing . . . rotating the blowing element . . . and actuating the controller. No other source of power or energy is required. Compressed air is supplied by a relatively small compressor-receiver unit because of "Air Puff" (measured interval) blowing.

Simple, inexpensive, effective, the Diamond "Air Puff" System does a remarkable job at low cost. Cleaning by air puff is more efficient . . . requires less installation and maintenance expense.

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO
Diamond Specialty Limited—Windsor, Ontario

Now... Longer Life Between Gauge Cleanings

with the NEW and IMPROVED

"HI-LITE" ILLUMINATOR

for DIAMOND Bi-Color Gauges

Using lamps similar in general construction to "sealed beam" automobile headlamps, the new Diamond "Hi-Lite" Bi-Color Gauge Illuminator is a definite improvement over previously used sources of light. This type lamp has a reflector sealed inside where it *cannot* get dirty. The face of the lamp is easily accessible for cleaning . . . as are all other parts of the illuminator.

A very high level of illumination is maintained throughout the long life of the lamps. This provides greatest possible color contrast at water level . . . permits longer time between gauge cleanings, therefore reducing maintenance. The gauge remains easily and clearly readable when dirty mica would otherwise make reading difficult.

The Diamond Bi-Color Water Gauge makes use of an unvarying optical principle to show water green . . . steam red. With proper illumination, water level is unmistakable . . . whether viewed directly, or through a system of mirrors, or on control panel by use of Diamond "Utiliscope" (Wired Television). Ask for new Bulletin No. 1051 U.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
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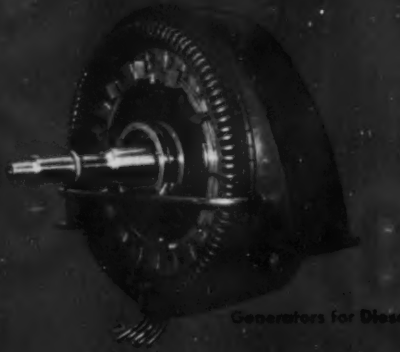
GREATER COLOR CONTRAST AT WATER LEVEL

EASY ACCESSIBILITY FOR QUICK MAINTENANCE

REDUCED MAINTENANCE COSTS

Write for
NEW BULLETIN NO. 1051

ELLIOTT
equipment for power and process



Tops in

HERE'S WHY

this Elliott turbine is the natural choice among men who demand sound performance with low maintenance:

AIRWALL LABYRINTH SEALS WITH NO RUBBING CONTACT protect bearings against dust, fly ash, etc. —

CENTERLINE SUPPORT assures constant alignment at all times, irrespective of possible expansion due to temperature changes —

PACKING GLANDS REMOVABLE without raising upper half of turbine casing —

SHAFT IS SPRAY-COATED WITH STAINLESS STEEL under the packing gland, eliminating special maintenance after shutdown —

TURBINE BUCKETS AND SHROUD OF STAINLESS STEEL for maximum life and sustained efficiency —

ROTORS DYNAMICALLY BALANCED for smooth operation —

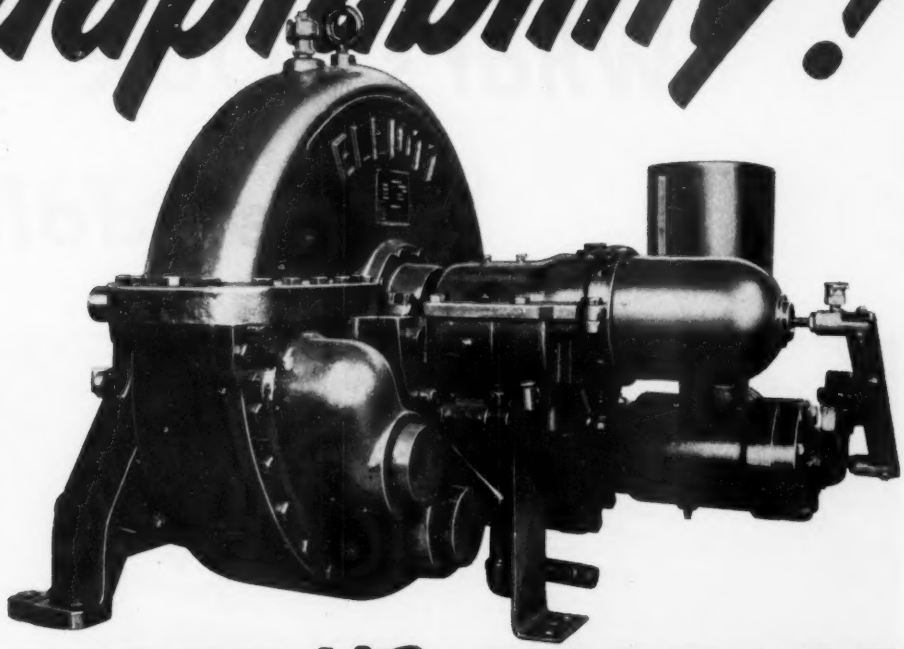
CONSTANT-SPEED GOVERNOR READILY ADJUSTED for permanent speed change —

BUILT-IN STEAM STRAINER of heavy stainless steel and

STANDARDIZED PARTS that fit all YR Turbines, greatly reducing parts inventory.

Bulletin H-16 has the full story. Phone or write your nearest Elliott office.

adaptability!



ELLIOTT YR TURBINE

HERE'S WHY ***this popular turbine can be adapted to practically any operating conditions:***

- **Six elective control devices, including:**
  1. *Two handvalves controlling nozzling*
  2. *Hand-operated speed changer*
  3. *Remote control speed changer, air or electric*
  4. *High exhaust-pressure trip*
  5. *Remote control electrical trip*
  6. *Hand throttled emergency trip valve.*
- **Five frame sizes**
- **Eight different turbine types**
- **Your choice of several governors each independent of the standard overspeed governor**
- **Gland seal piping for condensing operation, or operation with gas**
- **Exhaust connection on either side**

ELLIOTT Company Q2-5

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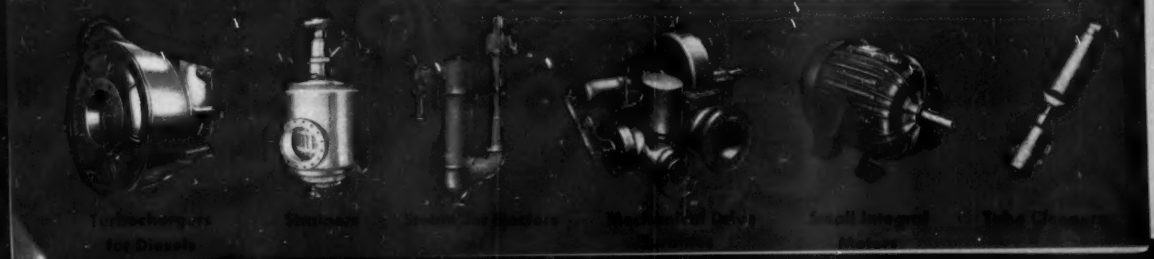
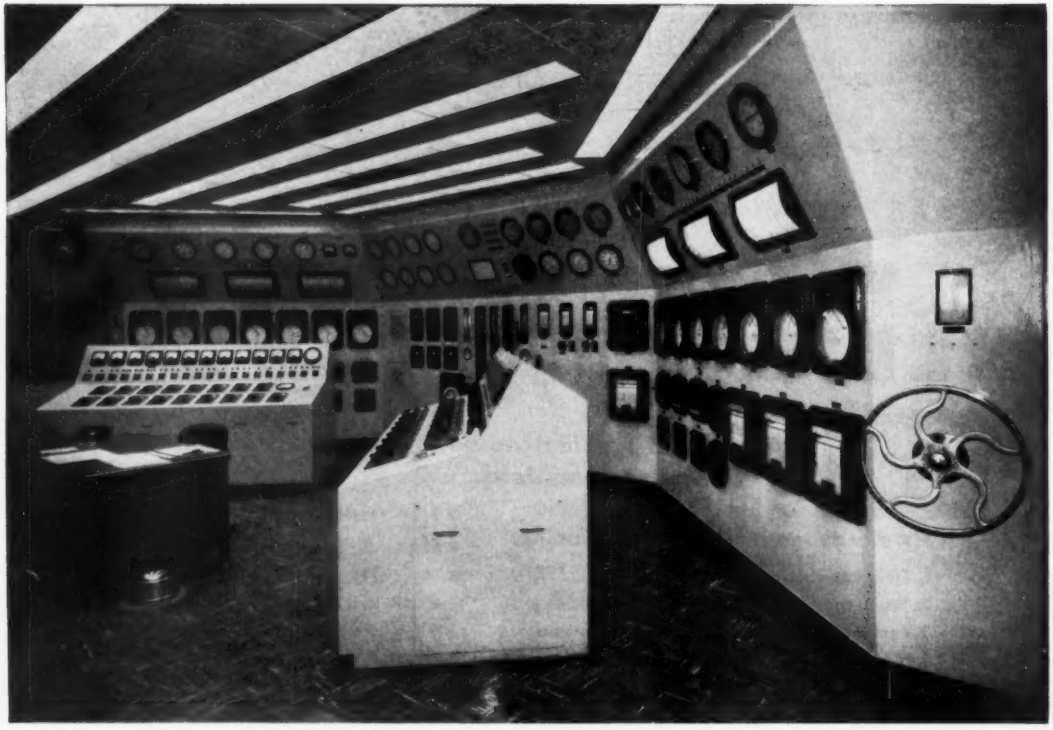


What's YOUR Fuel-dollar



This Centralized Boiler Control Room insures high efficiency in the use of Fuel-dollars at the Mustang Station of Oklahoma Gas and Electric Company. It includes Bailey Meter Combustion Control, Bailey Three-Element Feed Water Control, Bailey Steam Temperature Control, and Bailey Feed Water Pump Recirculating Control for two gas-fired boilers.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Efficiency ?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109

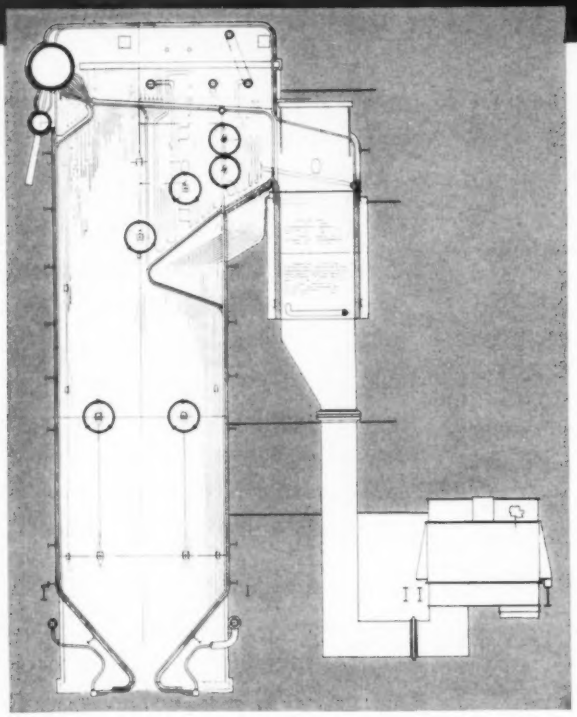
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

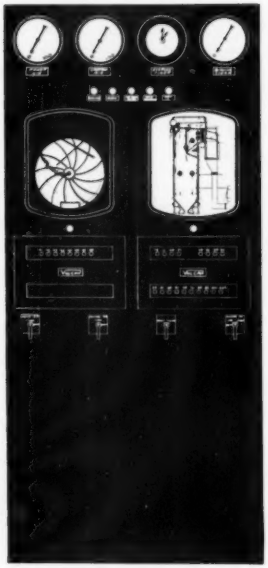
BAILEY METERS

PENELEC SWINGS to

at its new



Penelec at Front Street is adding two Combustion Engineering-Superheater radiant type boilers fired with pulverized coal or oil, each rated at 400,000 pounds per hour at 1250 psi and 950 degrees FTT. Soot blowing will be by steam, with air-powered long retractables, rotary units, wall blowers and air-heater blowers under Vulcan Automatic-Sequential Control.



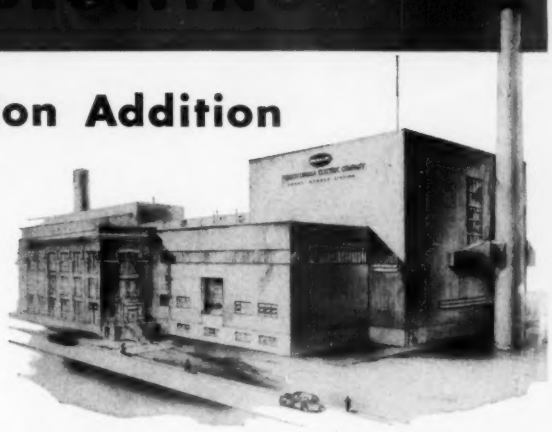
Lights on the boiler diagram will show that each blower operates in correct sequence and for the proper time. Centralized at the panel, soot blower control is flexible to meet any operating need.

VULCAN -Automatic

VULCAN

AUTOMATIC—SEQUENTIAL SOOT BLOWING

Front Street Station Addition



Now using Vulcan on the 675-psi boilers at Front Street and Seward —and on 875 psi boilers at Warren —Pennsylvania Electric Company is swinging to Vulcan Automatic-Sequential Soot Blowers for the new 1250-psi boilers in the Front Street Station addition at Erie, Pa.

Better boiler cleaning is sure, because blower operation will be positive and at proper intervals.

Steam will be saved, since each blower will operate for exactly the correct cleaning period and no more.

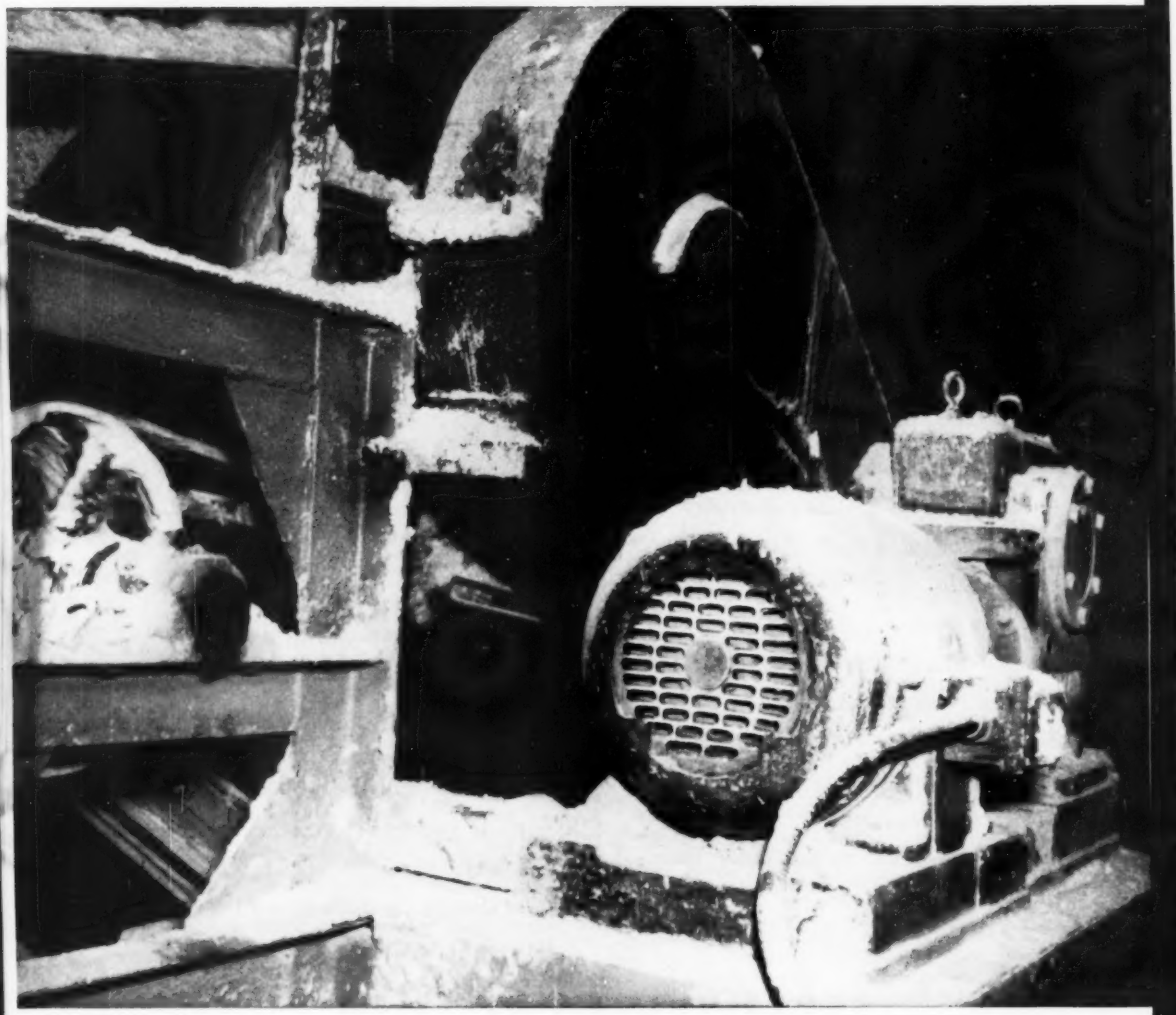
Time will be saved, for operators will start the sequential soot blowers from the panel—no need to climb to remote locations.

Operation will be dependable, for complete protective devices are provided for all units.

Get details in Bulletin 483.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

INDUSTRY DOES THE



THE CHEMICAL INDUSTRY depends on standard, "off the shelf," Tri-Clad motors in the most adverse operating conditions, including corrosive, abrasive and explosive atmospheres. The 7½-hp totally-enclosed fan-cooled Tri-Clad motor above drives a crude ash conveyor an average of over 23 hours every day.

GENERAL ELECTRIC

752-12

TOUGH JOBS WITH TRI/CLAD MOTORS

REG. U.S. PAT. OFF.

EXTRA PROTECTION

Every Tri-Clad motor, open or totally-enclosed, is triply-protected against *physical damage, electrical breakdown* and *operating wear and tear.*

That's why you'll find general-purpose Tri-Clad motors in every industry—not only on the usual jobs which they do so economically—but on the *tough* jobs where unfailing performance is a must.

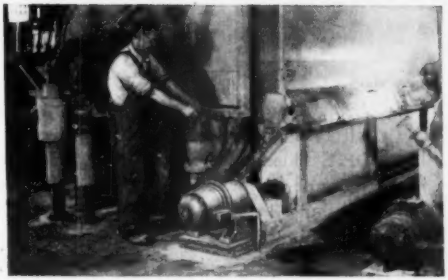
PROMPT DELIVERY

Today especially, delivery and service are important. G-E shipping points all over the country are ready to deliver most standard ratings right out of stock. And with the most complete service shop network in the motor industry you are assured of the best attention to motor problems.

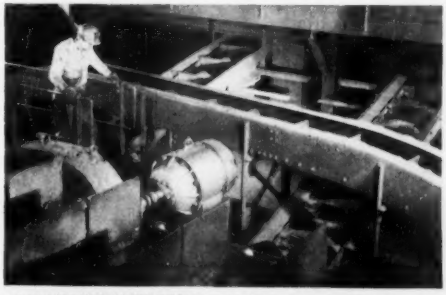
TIMELY INFORMATION AVAILABLE

If you are concerned with training manpower, the new G-E Motor Selection and Application Course, including nine strip films, is a unique and valuable aid. A sample copy of the "Instructor's Manual" (GEZ-310), which outlines the course, may be obtained on request.

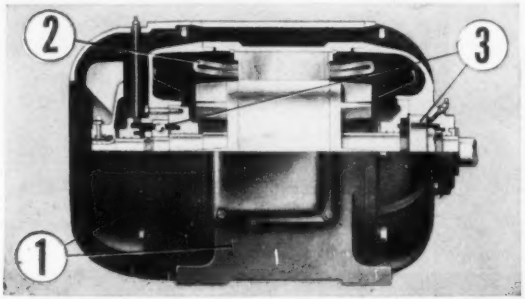
Also available is a free bulletin on "How to Maintain Motors and Generators" (GET-1202). Contact your local G-E sales office for any of the above material, or write *Section 752-12, General Electric Co., Schenectady 5, N. Y.*



FOOD PLANTS on "continuous process" operation depend on Tri-Clad motors to avoid costly shut-downs. Totally-enclosed, non-ventilated Tri-Clad gear-motor above drives a repulper in a sugar refinery.

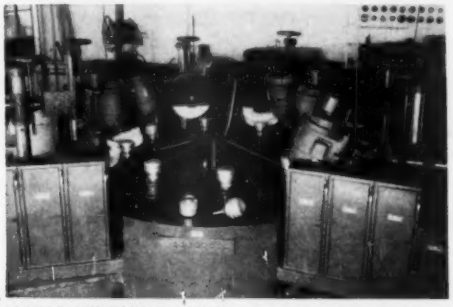


MINING INDUSTRIES know Tri-Clad motors can take abuse, don't twist out of line and are corrosion-resistant. This totally-enclosed, fan-cooled, Tri-Clad motor runs a coal conveyor.



UNINTERRUPTED SERVICE under tough conditions is assured by many outstanding features of Tri-Clad totally-enclosed motors, for example: 1 rigid, cast-iron end shields and frame; 2 Formex* windings which resist oil, heat, shock, moisture, abrasion; 3 *completely* enclosed bearings that will last longer because provision is made for relubrication if necessary.

Reg. trademark of General Electric Co.



METAL WORKING FIELD likes Tri-Clad motors because they're easy to mount in any position, rigid and smooth running, and *can be relubricated if operating conditions warrant—without disassembly!* Six 7½-hp TEFC Tri-Clad motors run machine above which polishes 500 to 1000 metal coffee-makers per hour!

At PLANT YATES of

. . . COPES APPLIED TO HYDRAULIC

GIVES PRECISE FEED AND LEVEL

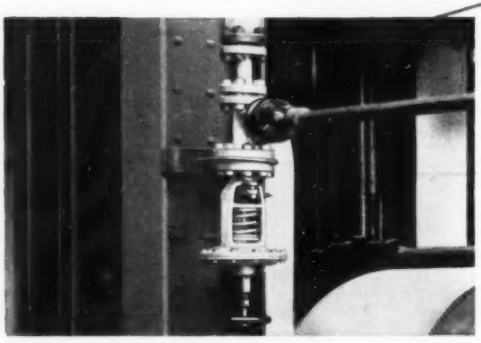
Remarkably close feed-flow and water-level control is being demonstrated daily by the COPES Balanced Flow Control at Plant Yates of Georgia Power Company, Newnan, Georgia. Units 1 and 2 went into service late in 1950.

Each unit includes a 3-drum, dry-bottom, radiant-type Combustion Engineering-Superheater boiler designed for a maximum continuous rating of 975,000 pounds per hour. Loads have been carried as high as 1,050,000—as low as 250,000—pounds of steam per hour.

The COPES Control, applied through the hydraulic couplings of the feed pumps, matches feed flow almost perfectly to steam flow, and stabilizes water level within plus-or-minus one inch. Independent of meters and other controls, it can remain on full-automatic when they must be out of service for any reason. Duplicating COPES Control is on order for Unit 3, scheduled to start operation next winter.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

***Headquarters for* Feed Water Regulators, Pump Governors, Differential Valves, Level Controls, Hi-Low Alarms, Reducing Valves, Desuperheaters**



COPES Recirculating Valve used with the Minimum Flow Control System to protect the pumps on light loads.

Air impulses from the COPES Balanced Flow Control actuate this controller on the hydraulic coupling to control the speed of each boiler feed pump.

COPES

BOILER FEED

GEORGIA POWER COMPANY

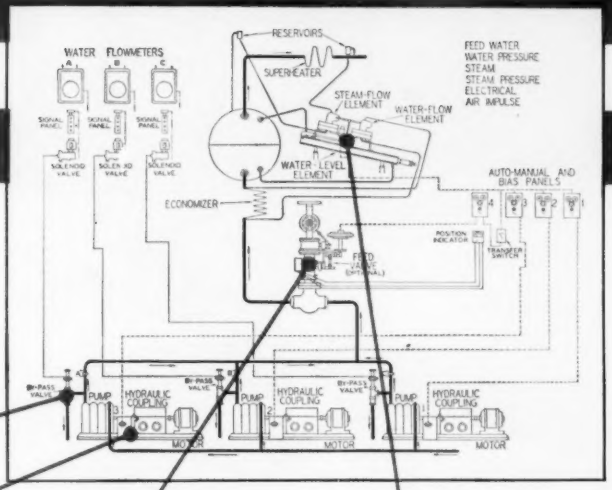
COUPLINGS

CONTROL

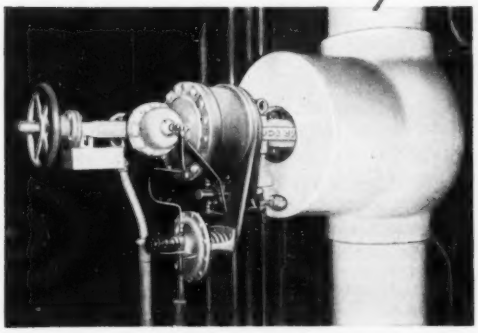
Shown schematically is the COPES Balanced Flow Control installed for each boiler at Plant Yates. Responsive to three influences—steam flow, feed flow and water level—the COPES applies air impulses to position the individual controller for the hydraulic coupling of each motor driven pump. Two pumps are normally parallelled with the third on standby, but any pump can be cut in or out by pushing the button to start or stop its motor.

The feed valve is normally wide open, but can be cut into automatic service at any time.

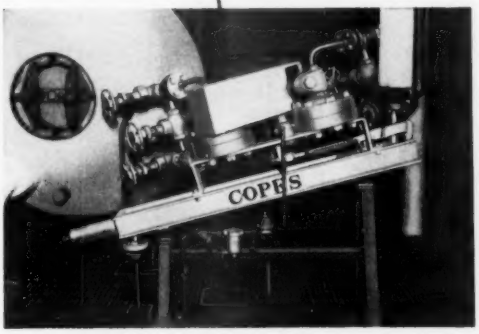
COPES Minimum Flow Control protects the pumps against overheating on light loads.



How well this system controls both feed flow and water level is shown by a new COPES Performance Report which also covers installations in two other Georgia Power Company plants. Charts are reproduced, as are boiler drawings and equipment photographs. *Write for Bulletin 489.*

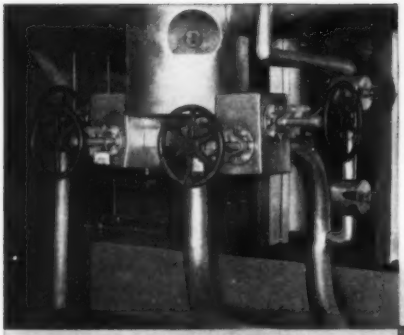


The COPES Feed Valve, installed in a vertical line, is normally wide open but may quickly be placed on fully-automatic, if and when this is desired.



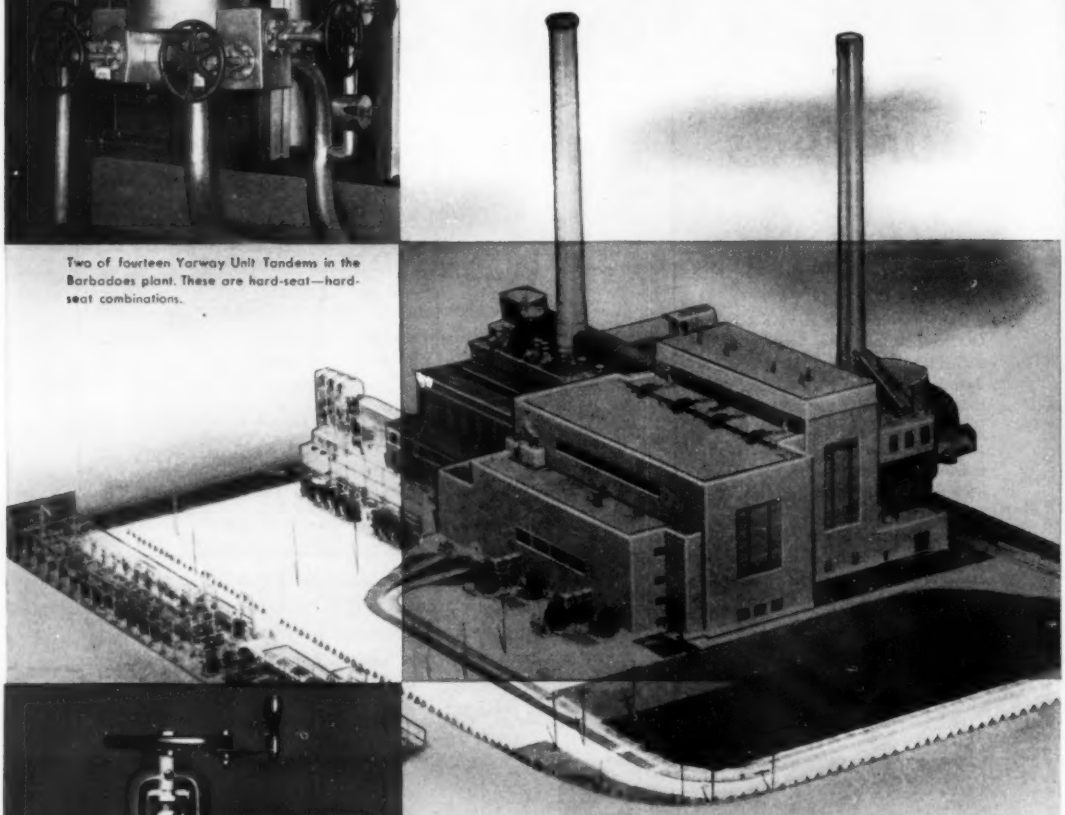
The COPES Balanced Flow Thermostat has steam-flow and water-level elements mounted rigidly on the frame of the water-level element. It is rugged.

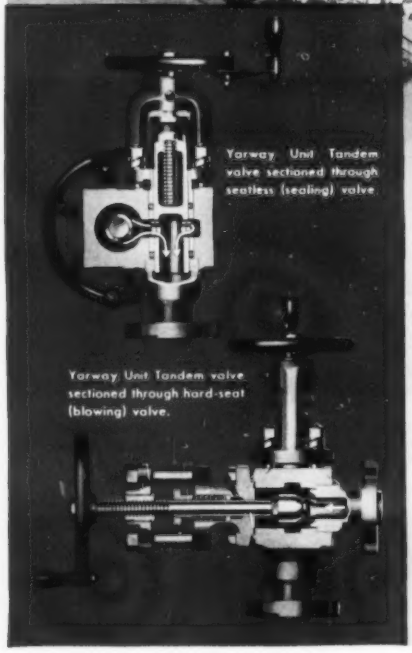
WATER REGULATION



Two of fourteen Yarway Unit Tandems in the Barbadoes plant. These are hard-seat—hard-seat combinations.

BARBADOES BOILERS GET





Yarway Unit Tandem valve sectioned through seatless (sealing) valve.

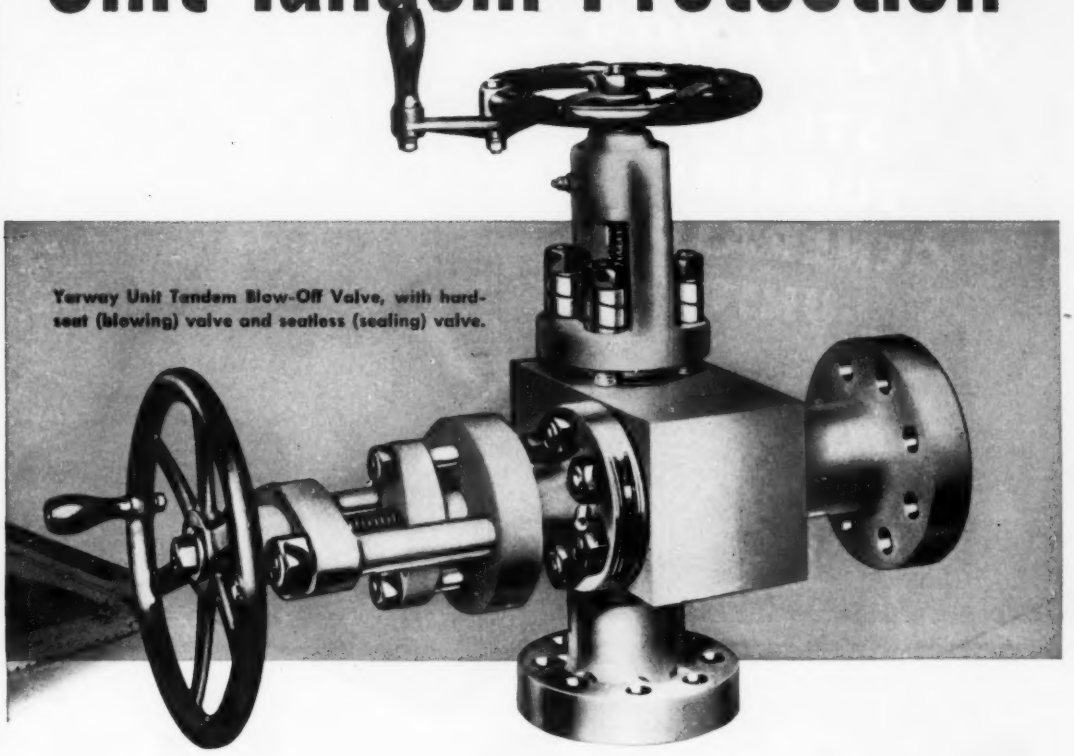
Yarway Unit Tandem valve sectioned through hard-seat (blowing) valve.

■ When a company has a $25,000,000.00 stake in the future such as Philadelphia Electric Company does in its Barbadoes Station —then protects the boilers of that plant with Yarway Unit Tandem Blow-Off Valves—it's significant of the dependability of those valves.

Barbadoes is a fine example of modern power plant engineering, demonstrated by the fact that only 11 men per shift are needed for operating this 180,000 KW station.

YARWAY

Unit Tandem Protection



Yarway Unit Tandem Blow-Off Valve, with hard-seat (blowing) valve and seatless (sealing) valve.

Yarway Unit Tandem Blow-Off Valves also are a good example of steam equipment engineering—used in more than 4 out of 5 high pressure boiler plants in the country.

Rugged construction makes Yarways strong and tough enough to withstand severest blow-down conditions. Metallurgical improvements make them resistant to the reactions of periodic acid wash. *Outages are rare where Yarway boiler valves are used.*

Unit tandems are available in various combinations to meet all pressure and service requirements.

Write for Bulletin B-433 for full details on Yarway Unit Tandems. For lower pressure blow-off valves, write for Bulletin B-424.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

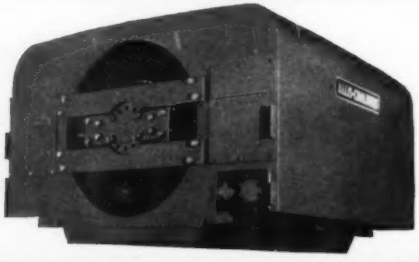
STEAM PLANT EQUIPMENT

WA-Series

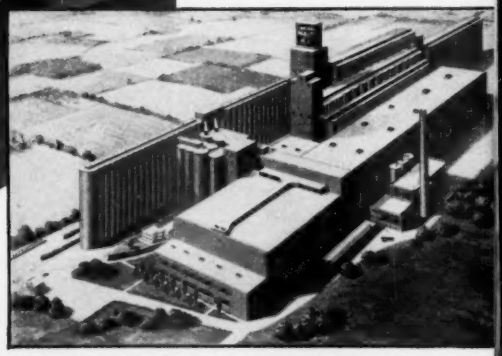
STEAM TURBINE GENERATOR UNIT

Doing Double

AT ONE OF WORLD'S LARGEST MALT



SIMPLIFYING INSTALLATION, both turbine and generator (shown at left) are shipped as complete assemblies with the rotors locked in place. The WA-Series generator is of the housing type with air-coolers mounted in the stator above the floor lines, eliminating special coolers and duct work.



Ladish Malting Co. Uses Steam for both Processing and Power Generation

Duty

HOUSES!

GREAT QUANTITIES OF STEAM are required in the process of manufacturing 10 million bushels of malt annually at the Ladish Malting Co., Jefferson Junction, Wisconsin. And, as an economic by-product, the electric power needed for plant operation is generated by the same steam.

When this world's largest single unit malt house recently needed more generating capacity, Allis-Chalmers again was chosen. And with good reason, since two Allis-Chalmers units had been supplying the electric power consumed at the Ladish Malting Company for nearly fifteen years.

Installed in 1951, the modern 2500 kw WA-Series unit shown here is now on 24 hr a day, 7 day a week duty. It consists of a non-condensing impulse steam turbine and housing type air-cooled generator and exciter . . . carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA ratings through 7500 kw, a modern WA-Series unit also will enable *your* power plant to meet tomorrow's expanded power demand. Complete details contained in new Bulletin 03B7654. For your copy, just call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3601

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

MODERN MASTERPIECE by U.S. Industry

S.S. United States, New Flagship of American Merchant Marine, Protected by World's Greatest Lubrication Knowledge!

SAILING on her maiden voyage this summer, the 990-ft. S.S. *United States*, largest and fastest liner ever built in America, represents a cross section of U. S. industry . . . a composite of industrial lubrication problems.

Every state contributed to her construction, more than 800 firms supplied materials. Represented are the steel and aluminum industries, metal working, power generation, air conditioning, refrigeration, chemical, textile, plastics, electrical—many others.

Lubrication a Big Problem

The cutaway view shows a small portion of the machinery that powers and operates this world's

Designed by Gibbs & Cox, Inc. Built by Newport News Shipbuilding and Dry Dock Company.

most modern ship. It also indicates why the S.S. *United States* — containing many of the same machines found in plants, mills and mines — presented lubrication problems as complex as any ever encountered in industry.

To solve these problems — to protect giant steam turbines, intricate hydraulic systems, generators, compressors, precision instruments and controls — United States Lines called on Socony-Vacuum.

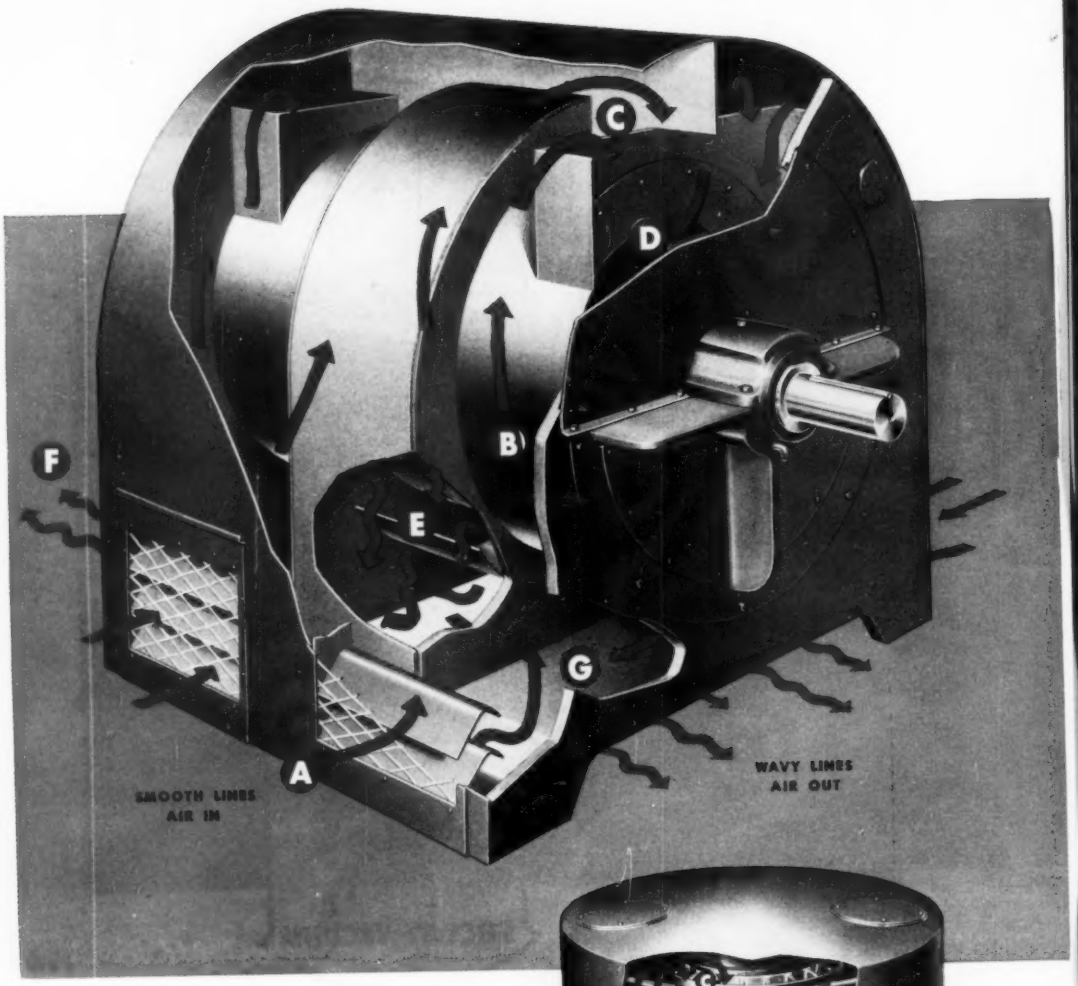
Today, the S.S. *United States* is protected stem to stern by a complete program of Correct Lubrication. This same unsurpassed protection is available to *you*. Why accept anything less?

SOCONY-VACUUM

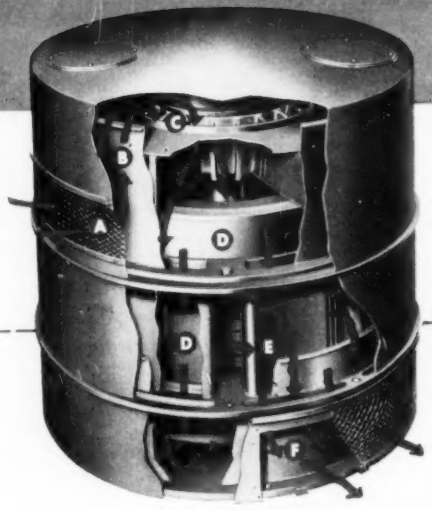
Socony-Vacuum

Correct Lubrication

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION



VERTICAL OUTDOOR MOTOR



New Outdoor Motor

dares weather to do its worst!

You can install these induction motors outside—any place—and forget the weather. They're naturals for power station auxiliary service, in fact, any place where a motor must stand up to weather—wind, rain, or hail as long as the ventilated openings are unobstructed.

Look at the cutaway drawing at the left. You can see that the motor is completely enclosed by a steel shell. Note how air enters the shell at the bottom (A), flows up and around in the motor shell (B), to top (C), where it is drawn down and into the interior of the motor (D). Warm air is discharged from motor (E) and out enclosure ends (F).

Now, what happens when moisture, rain and sleet are present in the air? The air is drawn in at point (A). As the air rises at a slow velocity, water, sand and other heavier-than-air particles fall to base (G) where a drain carries them away. Result? Regardless of outside conditions, only clean dry air enters the motor.

For example: Sectional covers and air shields, easily removed by hand. Split bearing housings, with bearings readily accessible for inspection or replacement. Sturdy welded steel frame; stronger, lighter, smaller.

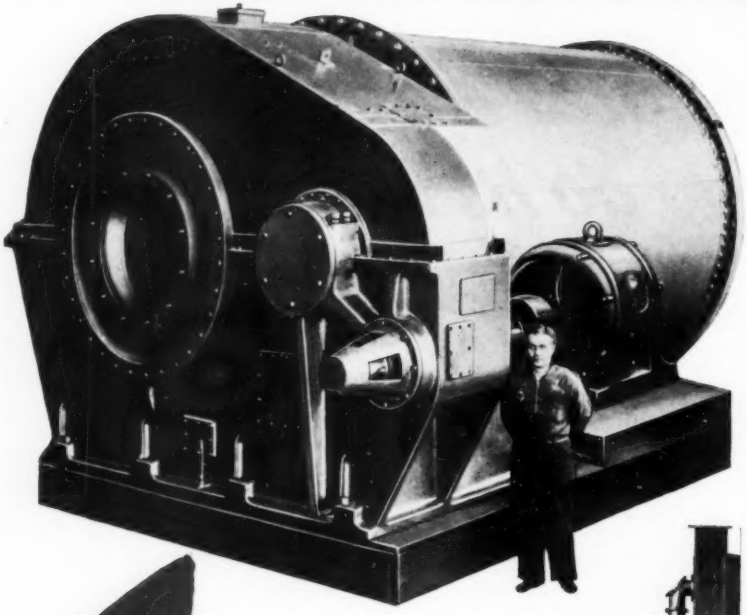
Also, vertical-type outdoor motors are available with features that have made Westinghouse motors leaders in industry.

Get the facts now for immediate use or with an eye toward future requirements. See your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10375

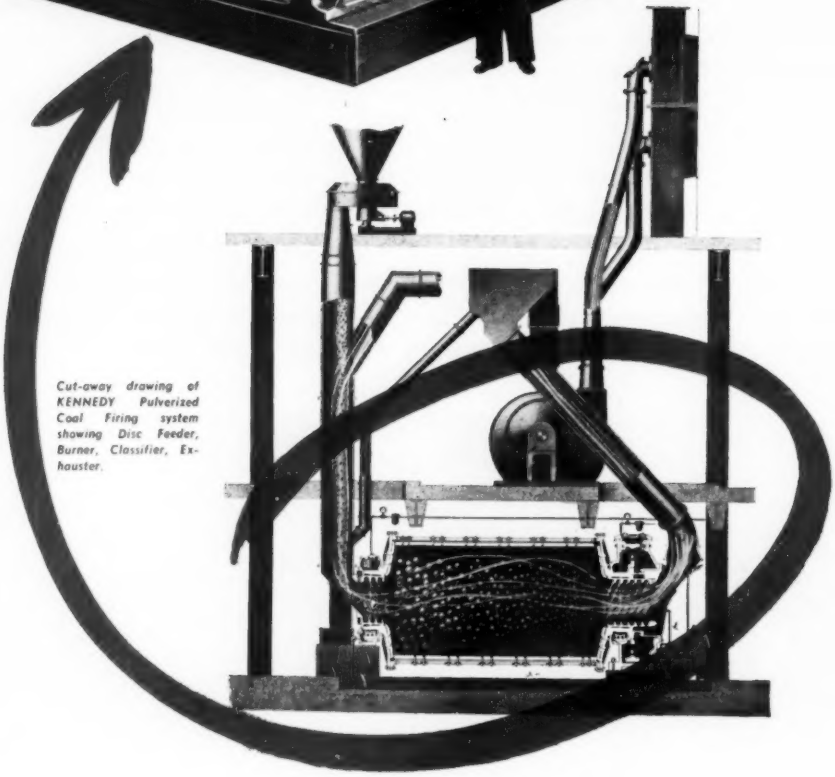
YOU CAN BE SURE...IF IT'S Westinghouse

LARGE INDUCTION MOTORS

What a difference KVS



KENNEDY Integral Gear Driven Air Swept Tube Mill showing steel housing and dust-tight cover.



Cut-away drawing of KENNEDY Pulverized Coal Firing system showing Disc Feeder, Burner, Classifier, Exhauster.

Pulverized Coal Firing makes in Fuel Costs!

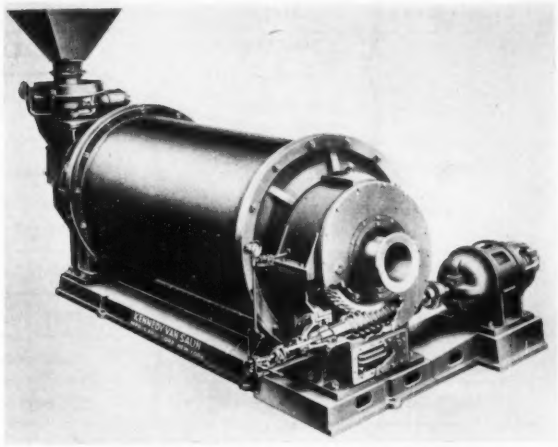
SAVINGS EFFECTED THROUGH RAPID AND COMPLETE COMBUSTION, UNMATCHED BY ANY OTHER TYPE

The KVS Pulverized Coal Firing System presents exclusive features that spell ECONOMY in capital letters. Heating properties of every grade of coal utilized to its utmost capacity . . . fuel and maintenance costs cut to a minimum . . . with KVS coal firing installations in steam generating plants.

Low price coal, slack—even high ash content is pulverized to extreme fineness by KVS grinding methods. Our mills are outstanding in performance and economy of operation because advanced engineering and world-famous manufacturing procedures are combined to assure long, continuous and satisfactory service.

KVS plus values include: Reduction gears mounted in self-aligning roller bearings, enclosed in dust-proof cover. Famous KVS lubricating system equipped with automatic "Alarm Circuit" for instant detection of leakage or pump failure. Cooling coils prevent oil from overheating when grinding coal for power plant usage.

Let KVS engineers furnish complete designs for your steam and coal pulverizing requirements. Plans and specifications submitted to assure lower operating and fuel costs. Get the facts . . . learn why "It Costs Less To Own The Best."



KENNEDY Worm Driven Air Swept Tube Mill with Disc Feeder.

FEATURES WHICH MAKE KVS EQUIPMENT PREFERRED IN MODERN POWER PLANTS

- Unburnt carbon losses held to less than one-half of one per cent at all ratings
- Instant response to combustion controls
- Up to 20 per cent moisture evaporated in the mill
- Grinding balls can be added without shutting down
- High efficiency not affected by load changes
- No magnetic separation used. Tramp iron actually helps grind coal
- Uses lowest price coal obtainable
- Continuous, year-to-year operation. Availability better than 99 per cent

IT COSTS LESS.. TO OWN THE BEST!

KENNEDY - VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK
FACTORY DANVILLE, PA.

Ready FOR ANY FUEL JOB

NAME OF COAL	CHARACTER	MINE
Sonman	Central Pennsylvania Low Volatile	Sonman
Indian Creek	Central Pennsylvania Medium Volatile	Melcroft
Federal	Northern West Virginia	Federal #1
Bergoo		Bergoo #2
		Bergoo #4
		Bergoo #6
Bolair		Bolair
Eccles	Southern West Virginia Low Volatile	Eccles #5
Stotesbury		Eccles #6
		Helen #9
New River		Stotesbury #8
		Stotesbury #11
		Carswell
Pocahontas		Keystone
		Maitland
Eagle	Southern West Virginia and Eastern Kentucky High Volatile	Beards Fork
		Page
		Kopperston #1
Nuttall Gas		Kopperston #2
Powellton		Powellton #3
Wharton		Wharton #1
		Wharton #2
Weeksbury		Weeksbury

There's never any need for compromising on the fuel properties you require for your particular combustion job, when you use Beacon Coal. You'll find, in this comprehensive line, a fuel that's exactly suited to each application: domestic hand and stoker fired; commercial hand or stoker fired; general industrial; electric utilities; railroad; steamship bunker; coke and gas plants; and special uses. Mine locations and shipping facilities, as shown on the chart, permit the most advantageous distribution. And finally, the conveniently located sales offices bring the able services of Beacon representatives within easy reach.

Want a copy of this chart for your fuel file?

If you'd like one of these ready-reference charts for file . . . just drop a line to the nearest office.

EASTERN GAS AND FUEL ASSOCIATES
BEACON COAL

EASTERN
PITTSBURGH · BOSTON

·This convenient Reference Chart shows why!

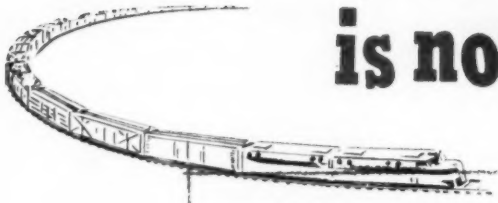
SEAM	COUNTY & STATE	RAILROAD	DIS-TRICT	SIZES MADE	DAILY PROD. TONS	NAME OF COA
"E"	Cambria (Pa.)	Penna.	1	Lump; Slack; M/R; N&S; Stoker	2500	So[illegible]an
"B" or Miller	Fayette (Pa.)	B & O	1	M/R; N&S; Slack	1200	Indi[illegible]Creek
Pittsburgh	Marion (W. Va.)	Monongahela; B&O	3	Stoker; Lump; Egg; Nut; N&S; Slack; M/R	10,000	Fe[illegible]al
Sewell	Webster (W. Va.)	Western Maryland	3	Lump; Egg; Jr. Egg; Nut; Stoker; Buckwheat; Slack; N&S	1500	
Sewell	Webster (W. Va.)	Western Maryland	3	Lump; Egg; Jr. Egg; N&S; M/R	1600	Be[illegible]oo
Sewell	Webster (W. Va.)	B & O	3	Lump; Egg; Nut; Slack; M/R	1000	
Fire Creek	Webster (W. Va.)	B & O	3	Egg; Nut; N&S; M/R	2000	B[illegible]r
Beckley	Raleigh (W. Va.)	C&O; Virginian	7	Egg; Stove; Nut; N&S; Slack	2000	Be[illegible]ey
Sewell	Raleigh (W. Va.)	C&O; Virginian	7	M/R; N&S; Slack	1000	S[illegible]ll
Pocahontas #3	Raleigh (W. Va.)	C&O; Virginian	7	Stove; Nut; N&S; Slack	2500	
Pocahontas #4	Raleigh (W. Va.)	C&O; Virginian	7	Stoker; M/R; Slack	2000	Ne[illegible]ver
Pocahontas #4	Raleigh (W. Va.)	Virginian	7	M/R; Slack	1800	
Pocahontas #3	McDowell (W. Va.)	N & W	7	Stoker; Egg; Stove; Nut; N&S; Slack; M/R	2500	
Pocahontas #3	McDowell (W. Va.)	N & W	7	Stoker; Egg; Stove; Nut; N&S; Slack; M/R	5000	Poc[illegible]ntas
Pocahontas #4	McDowell (W. Va.)	N & W	7	Stoker; M/R; Slack	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R; N&S	1000	E[illegible]e
Eagle	Wyoming (W. Va.)	Virginian	8	Slack; N&S; M/R	3000	
Campbells Creek	Wyoming (W. Va.)	Virginian	8	Slack; N&S; M/R	3500	No.[illegible]Gas
Powellton & Eagle	Fayette (W. Va.)	C & O	8	N&S; M/R	2000	Po[illegible]ton
Hernshaw	Boone (W. Va.)	C & O	8	Lump; Egg; N&S; M/R	3500	W[illegible]on
Hernshaw	Boone (W. Va.)	C & O	8	M/R; N&S	2500	
Elkhorn #3	Floyd (Ky.)	C & O	8	Block; Egg; Slack; M/R; N&S	1000	We[illegible]bury

GAS AND FUEL ASSOCIATES

CHICAGO · CLEVELAND · DETROIT · NEW YORK · NORFOLK · PHI[illegible]LPHIA · SYRACUSE

For New England: New England Coal & Coke Company · For Export: Castner, Curran & Bullitt, Inc.

working on the railroad is now 50% faster



An installation of Yarway Impulse Steam Traps on sand dryers convinced this railroad that Yarways were best for them. With Yarways, sand was dried in half the time! More important—in a 24-hour period, *twice the amount of sand can be handled.* Now they are standardizing on Yarway Impulse traps.

In all kinds of plants Yarway Impulse Steam Traps help increase production by *getting equipment hot in a hurry—and keeping it hot.*

Users like these additional features of Yarway Impulse Traps, too—one moving part, low maintenance, small size, good for all pressures, low cost. Over 800,000 Yarways have been installed. More than 200 Industrial Distributors stock and sell them.

TRY A TRAP—FREE!

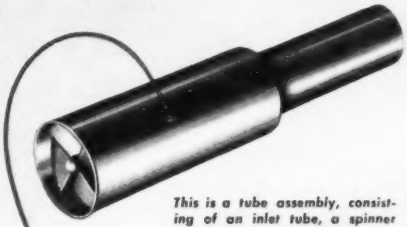
Be convinced. Install a Yarway Impulse Steam Trap on free trial anywhere in your plant. Send us a card and we'll send you the trial trap. For steam trap advice, call your nearby Yarway trap engineer.

YARNALL-WARING COMPANY
100 Mermaid Ave., Phila. 18, Pa.

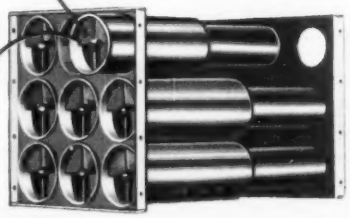
YARWAY the steam trap
designed with more production in mind

American Blower . . . a time-honored name in air handling

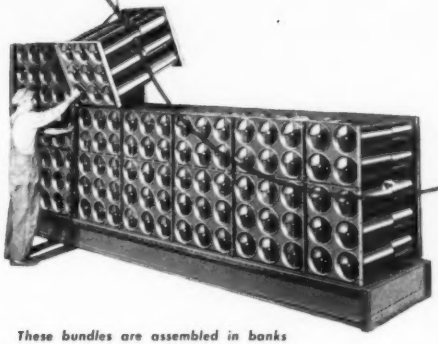
Beginning of the end of a fly ash problem



This is a tube assembly, consisting of an inlet tube, a spinner element and a smaller outlet tube.



Tube assemblies are grouped at the factory into convenient bundles, like the one above.



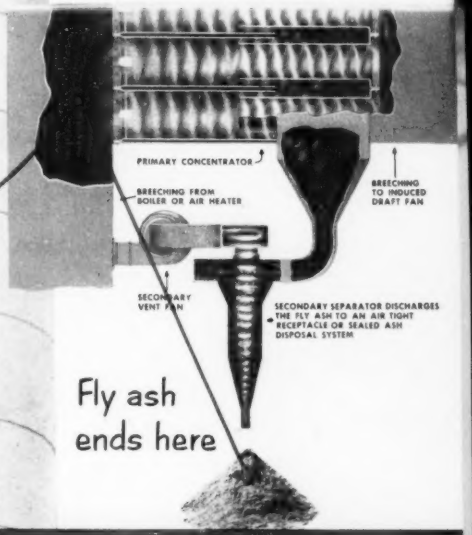
These bundles are assembled in banks to complete construction of the primary unit as your plant requirements dictate.

American Blower Type ST Precipitators are built up in banks, assembled at the factory, shipped in sections.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

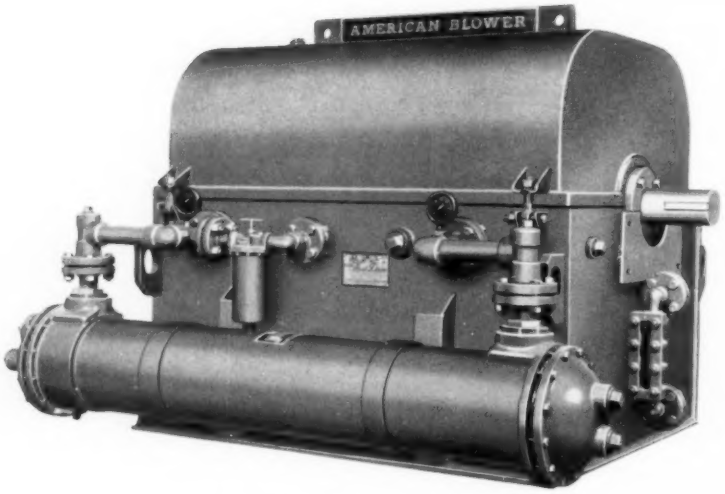

PRIMARY CONCENTRATOR
BREECHING FROM BOILER OR AIR HEATER
BREECHING TO INDUCED DRAFT FAN
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

Fly ash ends here

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

American Blower . . . a time-honored name in power plant equipment



American Blower Class 4 Gyrol Fluid Drive

Memo to Power Plant Men —

You'll save power, eliminate starting shocks, get stable control over the entire range with American Blower Gyrol Fluid Drives on your forced and induced draft fans. It's the best means we know of to get stepless control from approximately 98% motor speed down to 20% with a simple constant speed driving motor.

AMERICAN BLOWER

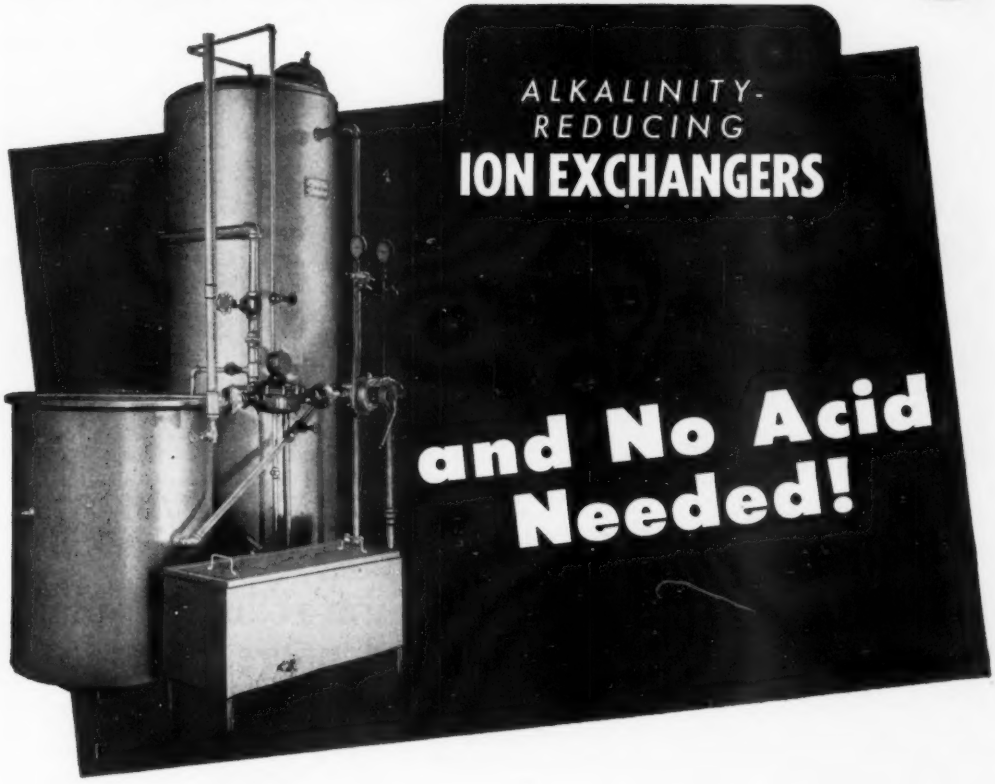
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Announcing



ALKALINITY-REDUCING ION EXCHANGERS

and No Acid Needed!

THIS SALT-SPLITTER SYSTEM removes both alkalinity and hardness by means of two resin beds in one tank. Needing only inexpensive salt — no acid — for regeneration, it offers these advantages:

1. Permits operation at alkalinities approaching zero, since no acid is present to damage equipment or produce acid water.
2. Eliminates costly rubber- and lead-lined tanks and piping.
3. Simplifies disposal of spent regenerant.
4. Provides complete safety for operating personnel.

Users of sodium zeolite softeners who find them unsuitable because of the high alkalinity of the effluent or who may be by-passing raw water for boiler make-up should definitely investigate the possibilities of incorporating this system into present installations.

For a concise explanation of the operation of this new combination of two proven water-conditioning methods, get a copy of the new Allis-Chalmers bulletin, 28X7808. Just fill in and mail the coupon.

Allis-Chalmers
Milwaukee 1, Wisconsin

Please send Bulletin 28X7808 describing alkalinity reduction by ion exchange.

Name

Title

Company

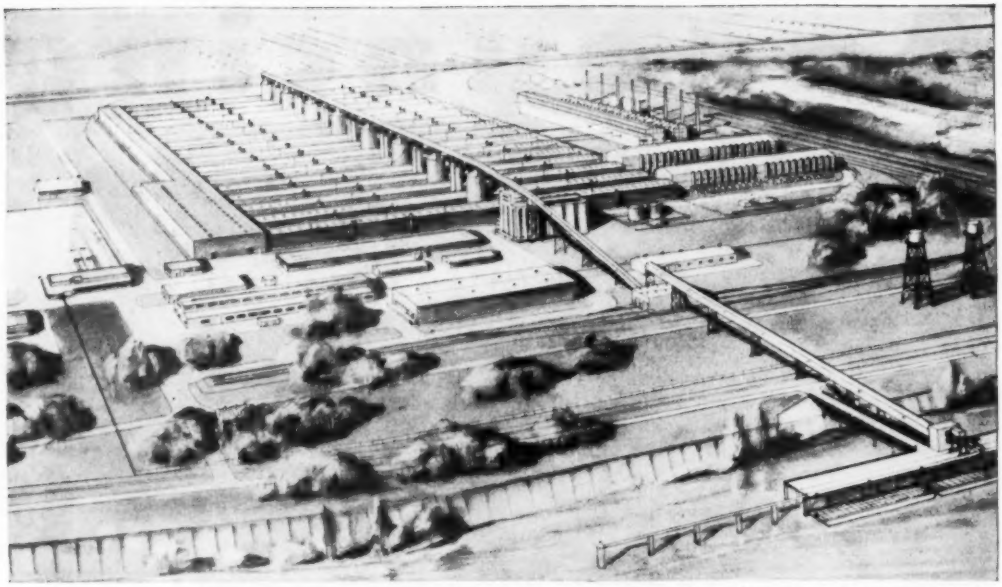
Address

City State A-3613

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE



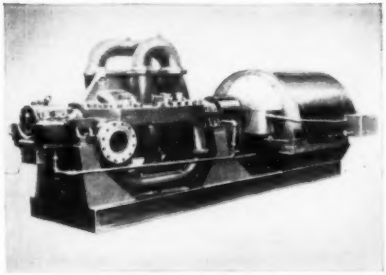
KAISER ALUMINUM AND CHEMICAL CORPORATION'S new 400,000,000 pound-a-year, $150,000,000 aluminum reduction plant at Chalmette, La., designed and built by Kaiser Engineers, is the largest plant of its kind in the U. S. The plant—where production began in December, 1951—uses 19 Worthington boiler-feed pumps and other Worthington equipment including thirty 9,300 square-foot condensers, and fifteen 250,000 pound-per-hour deaerators, 2 steam turbines and numerous circulating pumps.

Power plant at largest aluminum reduction plant to use Worthington pumps, condensers, deaerators

It takes plenty of electric power to produce 400,000,000 pounds of aluminum in a year. And that's what they're doing at the new Kaiser Aluminum plant at Chalmette, La.—largest aluminum reduction plant in the U. S.

Kaiser joins many other top companies in choosing Worthington boiler-feed pumps as well as other key equipment for their new plant. Such choices arise out of an insistence for equipment that's engineered for maximum performance.

Worthington engineering produces boiler-feed pumps of the most advanced design in the field, made from specially selected metals. Each pump is exactly *right* for the pressure and temperature with which it is to perform. Over 110 years of Worthington experience in building pumping equipment go into making this a certainty. Worthington Corporation, formerly Worthington Pump & Machinery Corporation, Centrifugal Pump Division, Harrison, New Jersey. C2.4



19 WORTHINGTON 250,000 LBS PER HR BOILER-FEED PUMPS at new Kaiser plant, handle feedwater at 257 F against a discharge pressure of 1,030 psig. Pumps are axial-balanced, volute type centrifugals. Two, similar to one illustrated, are driven by Worthington 450-hp steam turbines.

For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.

For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.

For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job

FOR LUBRICATING OR HIGHLY VISCOUS LIQUIDS you can't beat the double-helical gear rotary pump. Over thirty years' experience in a wide variety of services has proven this.

Worthington's double-helical or "herringbone" gear rotaries are specially designed to handle extremely viscous or lubricating liquids. Each unit operates smoothly and quietly whether its capacity is 1 or 5,000 gpm. All sizes have a maximum pressure rating of 500 psi.

Other advantages of these gear type rotary pumps are: their ability to handle a considerable amount of air or gas in the liquid, and their use with steam jackets for pumping liquids that become solid in normal temperatures. Types GA for general service, GR for heavy-duty service. Type GRJ is steam jacketed. All units can be arranged for motor, turbine, engine, or belt drive with conventional stuffing box or mechanical seal.

Here's your widest choice in rotary pumps —both gear and vane types

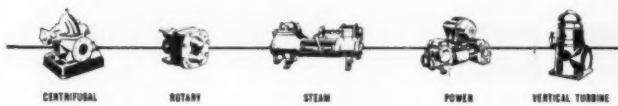
FOR NON-LUBRICATING, SLIGHTLY ABRASIVE OR CORROSIVE LIQUIDS, Worthington has built its heavy-duty sliding-vane type pumps. Here, the pressure of the liquid maintains contact of the vanes against the liner so that wear is automatically compensated for. All pumps are fitted with removable liners. End plates and vanes can be reversed if necessary.

External bearing models will handle non-lubricating, slightly abrasive or corrosive liquids without bearing failure, even though heads are relatively high.

External or internal bearings, capacities from 25 to 1,000 gpm, all with maximum pressure ratings of 200 psi. Type VE has external bearings, Type VR has internal bearings. Both available with or without relief valves.

Whether you pump lubricating or non-lubricating liquids, highly viscous or highly volatile, small or large capacities—check the *complete* Worthington rotary-pump line before you buy. For further information write for Bulletin W-487-B10B on Heavy-Duty Gear Pumps or Bulletin W-485-B1 on Vane Type Pumps. Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.

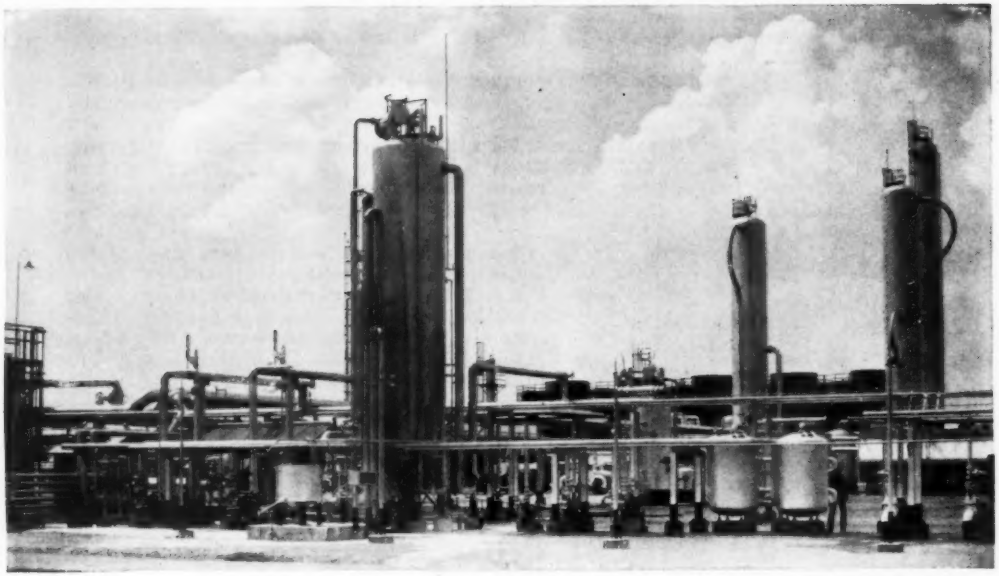
P.2.1



The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Rotary Pumps



NORTH COWDEN GASOLINE PLANT near Odessa, Texas, operated by Stanolind Oil and Gas Company. Here Worthington Water Softeners protect boilers from scale-forming deposits.

Worthington softeners protect this plant's boilers 10 ways

In this case, it's a hot-process softener to remove scale-forming deposits from boiler feedwater.

Let's examine this gasoline plant installation and see how it gives boilers "maximum" protection:

1. *Feed water is softened* by a hot-lime soda system.
2. *Selective deaeration* for operation on make up only, condensate only, or both.
3. *Non-scaling direct-contact vent condenser* heats and vents treated make-up.
4. *Tubular vent condenser vents condensate.*
5. *Oxygen contamination of feedwater avoided* by last-step deaeration.
6. *Stainless steel deaerating elements.*
7. *Uniform and efficient deaeration* during wide load swings.
8. *Filter backwashing* with clean, hot, chemically inert water without velocity change through the softening zone.
9. *Proportionate sludge removal.*
10. *Uniformly proportionate chemical feed.*

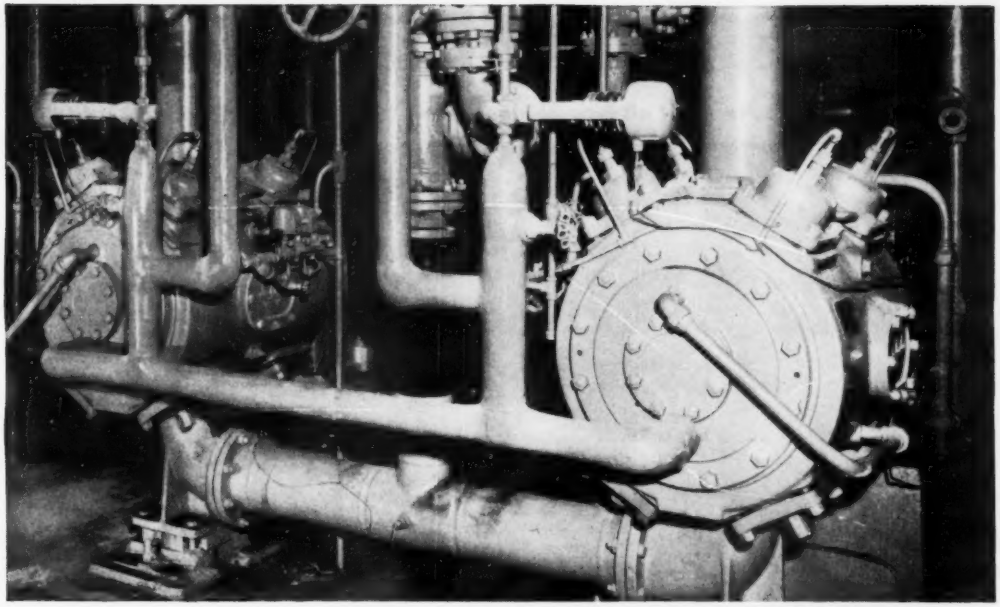
Before you buy, investigate Worthington Water Softening Systems thoroughly. Tell us the service conditions, and get our recommendations in terms of dollars and benefits. Write Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Water Treating Section, Harrison, N. J.

J.1.4

Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning



CONTINUOUS OPERATION of this Worthington Type DC Horizontal Compressor helps keep aureomycin production up at Lederle Laboratories plant in Pearl River, N. Y.

Compressor operates continuously to help produce aureomycin

Installed for Lederle Laboratories in 1949, unit operates at 100% capacity day and night.

No rest periods for this compressor. When you're producing antibiotics like aureomycin, you just can't afford them!

The Lederle Laboratories Division of American Cyanamid Company anticipated rigorous operating requirements when they installed this Worthington horizontal compressor back in 1949.

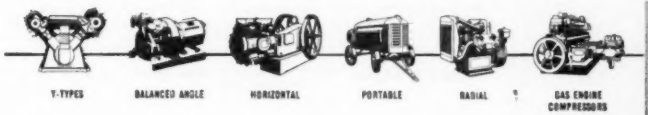
They wanted it to supply compressed air for use in the production of aureomycin—24 hours a day, seven days a week, at 100% capacity. The fact that the unit has operated since installation in 1949 with no attention other than routine maintenance is but "normal" for a sturdy Worthington compressor like this one.

This Type DC compressor has the exclusive Worthington Feather* Valve, Worthington's own automatic variable capacity control, and high efficiency Worthington intercooler—just some of the reasons why *there's more worth in Worthington.*

Remember Worthington's auxiliary equipment, too. Write to Worthington Corporation, Compressor Division, Buffalo, New York.

*Reg. U. S. Pat. Off.

K.2.1



No Other Compressor Will Outperform a Worthington

WORTHINGTON

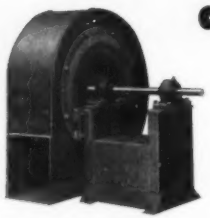
Compressors

HEADQUARTERS FOR AIR HANDLING AND CONDITIONING EQUIPMENT

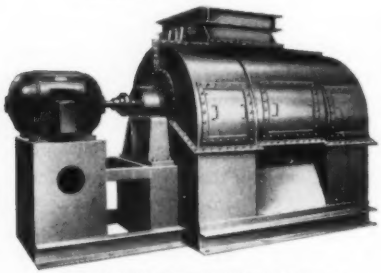
. . . . to meet all types of industrial, power plant, commercial and public building requirements.

CLARAGE

The Sign of Resourceful Engineering and Economical Performance



INDUSTRIAL FANS—for blowing or exhausting. Large range of capacity sizes—suitable for many applications.



MECHANICAL DRAFT FANS—both forced and induced draft. Heavy-duty construction for continuous operation at peak loads.

CAST IRON FANS—for industrial services. Unique construction assures extra long life when handling corrosive gases.

What you're looking for in air handling and air conditioning you are likely to find at Clarage Fan . . . highly efficient, dependable equipment — job engineered to your particular needs . . .

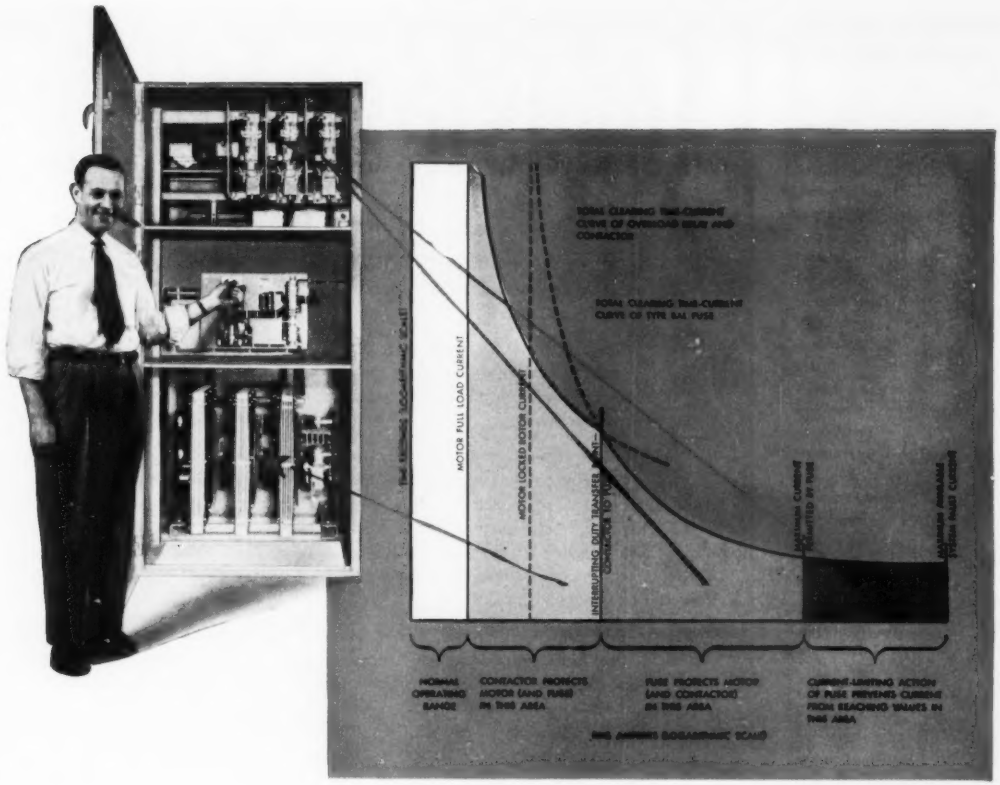
It's nearly 40 years since we started building fans, blowers and allied products. We have had ample time to temper research with experience, engineering with sound practice, manufacturing to actual operating in-the-field demands . . . .

You can profit by dealing with Clarage. We have an established reputation for getting things done right . . . . As evidence of what we mean, 97 of the 100 largest American corporations are users of Clarage fan equipment. Need we say more?

CLARAGE FAN COMPANY
615 PORTER ST., KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

IN CANADA: 4285 Richelieu St., Montreal
Canada Fans, Ltd.

You Can Rely on Clarage


MOTOR FULL LOAD CURRENT
MOTOR LOCKED ROTOR CURRENT
NORMAL OPERATING RANGE
CONTACTOR PROTECTS MOTOR (AND FUSE) IN THIS AREA
FUSE PROTECTS MOTOR (AND CONTACTOR) IN THIS AREA
CURRENT-LIMITING ACTION OF FUSE PREVENTS CURRENT FROM REACHING VALUES IN THIS AREA

This co-ordinated protection safeguards men, motors and circuits

Men? Motors? Circuits? Which can be ignored at a high-voltage motor installation? Obviously, NONE. Yet, high-voltage protective equipment is often installed that DOES NOT safeguard all three.

Protection must be co-ordinated to be complete. It must safeguard all elements under all conditions. Examine the above chart and note how a Westinghouse High-Voltage Combination Starter co-ordinates fuses and contactor to provide continuous protection for both motors and circuits. Note how the sectionalized steel cabinet protects personnel and equipment.

Co-ordinated protection also safeguards production. No chance for high current faults to bypass the starter and damage equipment. Down time is confined to correcting the fault and then reclosing the circuit.

The advantages of Westinghouse Co-ordinated Protection are many. Talk them over with your Westinghouse representative. Or, write for booklet B-4673 "High-Voltage Motor Starters". Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27029

YOU CAN BE SURE...IF IT'S
Westinghouse
HIGH VOLTAGE STARTERS

Industries served by VU Boilers

Aircraft
Asphalt
Automobile
Breweries
Building Materials
Carpet
Cellophane
Cement
Chemical
Coal Mining
Coke
Cold Storage
Dairy
Department Stores
Distilling
Explosives
Electrical Equipment
Electric Power
Food Products
Foundries
Gas Works
Gelatine
Glass
Hosiery
Knitting Mills
Institutions
Laundries
Leather
Linoleum
Locomotive
Lumber
Machinery
Metal Producing
Mining
Municipal
Oil Refining
Paint
Paper
Public Utilities
Radio
Railways
Refrigeration
Rubber
Schools
Sewage Plants
Shipbuilding
Sugar
Textile
Tobacco
U. S. Government

Industries follow

In industry after industry, you'll find leading companies are setting the pace for efficient, reliable steam production with C-E Vertical-Unit Boilers.

The Chemical Industry is a typical example. For VU Boilers have been purchased by most of the major manufacturers in this industry, including such nationally-known leaders as those shown in the list below.

Furthermore, chemical manufacturers, both large and small, have *proved* their satisfaction with Vertical-Unit Boilers by buying them again and again. In 1951, for example, more than 60 per cent of the VU capacity ordered by chemical companies represented repeat order business. One leading manufacturer, in fact, has purchased twenty-seven units during the past twelve years – *eleven of them in 1951!*

You can profit from the experience of the Chemical Industry – as from any industry where steam for power or process is of major importance. If you use steam, investigate the lower steam costs you can get through the advanced design . . . sound construction . . . proved reliability of VU Boilers. They are available in capacities to fit your needs–from 10,000 to 350,000 pounds of steam per hour.

Typical List of Chemical Companies that have purchased VU Boilers for one or more plants

Air Reduction Co., Inc.
Allied Chemical & Dye Corp.
Atlas Powder Co.
Carbide & Carbon Chemical Corp.
Colgate-Palmolive-Peet Co.
Diamond Alkali Co.
E. I. du Pont de Nemours & Co., Inc
B. F. Goodrich Chemical Co.
Hercules Powder Co.
Merck & Co., Inc.
National Distillers Chemical Co.
Pennsylvania Salt Mfg. Co.
Pittsburgh Coke & Chemical Co.
Charles Pfizer & Co.
Shell Chemical Co.
U. S. Industrial Chemicals Co.

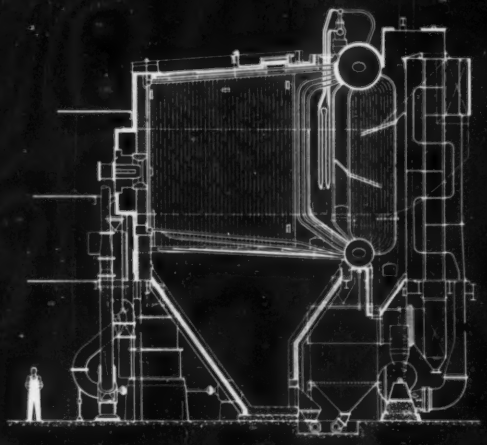
C-E

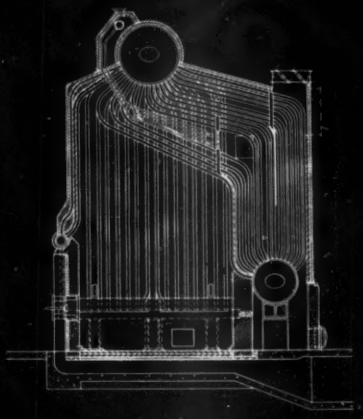
COMBUSTION ENGINEERING–SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL

VU

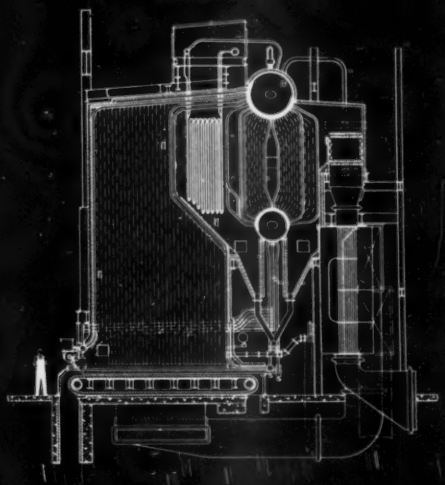




1 VU-50 BOILER installed in Midwestern plant. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 65,000 lb of steam per hr. Steam pressure is 400 psi — steam temperature is 600 F.

2 VU-10 BOILER fired with oil. Installed in an Eastern plant, the boiler's capacity is 15,000 lb of steam per hr at 250 psi and 480 F. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr. They may also be fired by spreader, underfeed or chain grate stokers.

3 VU-40 BOILER installed in a large Southern plant. This unit is fired by coal, using C-E Spreader Stokers (continuous discharge type). Capacity of this boiler is 150,000 lb of steam per hr at a pressure of 900 psi and a temperature of 808 F.

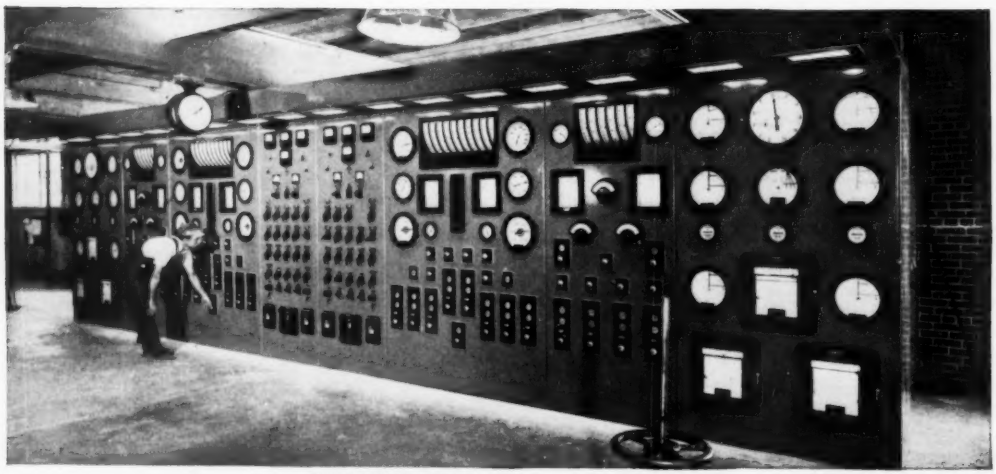


REPUBLIC
Combustion Control Systems

AN automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

Republic combustion control is a unified system controlling the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

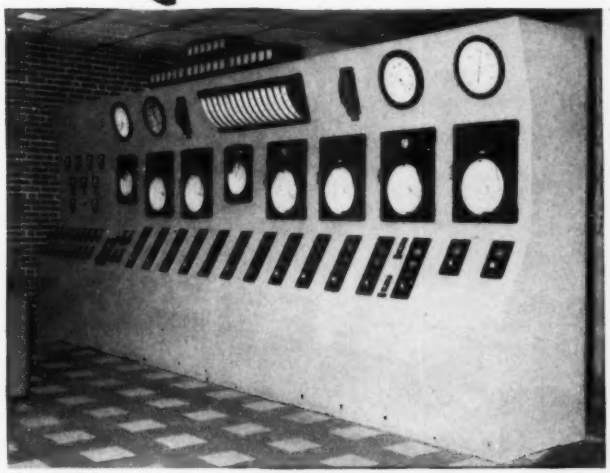
Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.



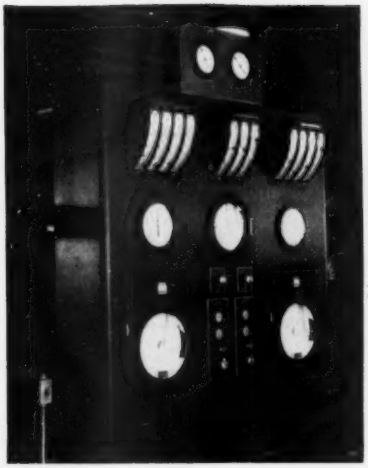
PULVERIZED COAL
In this modern central station steam is generated in two 600,000 lbs. per hr. pulverized coal fired boilers operated by a Republic Combustion Control System.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

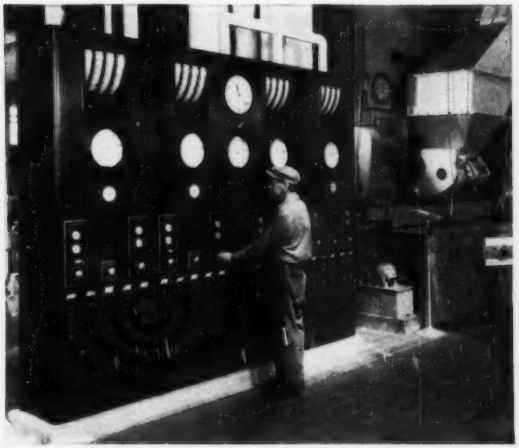
for { All Sizes of Boilers
All Types of Firing
All Arrangements of Draft
All Load Conditions



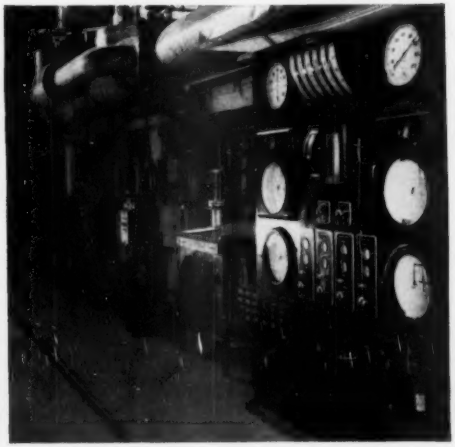
OIL FIRED
A typical Republic automatic boiler control and instrument installation in a large central station for the operation of a 450,000 lb. per hr. oil fired boiler.



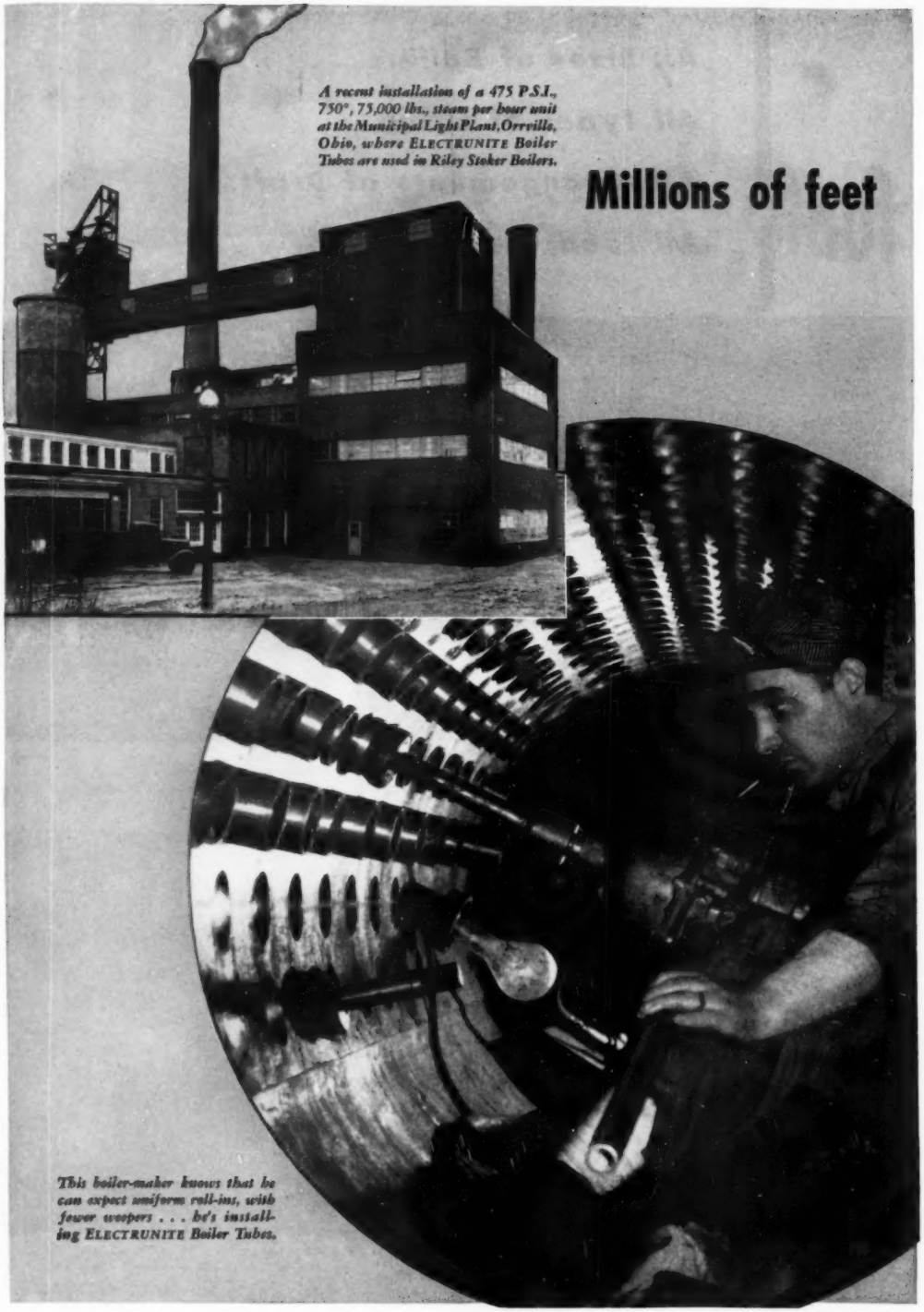
MIXED GAS
Republic instrument and controls for two 50,000 lb. per hr. boilers burning mixed gas.



STOKER FIRED
The Republic combustion control and instrument panel for the automatic operation of four 80,000 lb. per hr. stoker fired boilers.



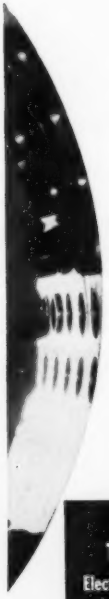
STOKER FIRED
In this modern industrial plant steam is generated in a 175,000 lb. per hr. stoker fired boiler operated by a Republic control system.


A recent installation of a 475 P.S.I., 750°, 75,000 lbs., steam per hour unit at the Municipal Light Plant, Orrville, Ohio, where ELECTRUNITE Boiler Tubes are used in Riley Stoker Boilers.
Millions of feet
This boiler-maker knows that he can expect uniform roll-ins, with fewer weepers . . . he's installing ELECTRUNITE Boiler Tubes.

in hundreds of boilers prove

ELECTRUNITE

BOILER TUBES . . .



. . . Prove ELECTRUNITE Boiler Tubes able to deliver years of trouble-free performance under all types of service . . . in large boilers and small, under high pressures and low, in central stations or small commercial installations.

Fully-normalized treatment provides predictable ductility and uniform grain to assure smooth roll-in wherever the tube-end occurs. Smooth, scale-free surfaces make ELECTRUNITE Boiler Tubes easy to insert without costly re-drilling or reaming of holes. Easy to roll-in for tight joints that are free from weepers.

Write for literature describing ELECTRUNITE Boiler Tubes, and giving you data and specifications.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 EAST 131st STREET • • CLEVELAND 8, OHIO

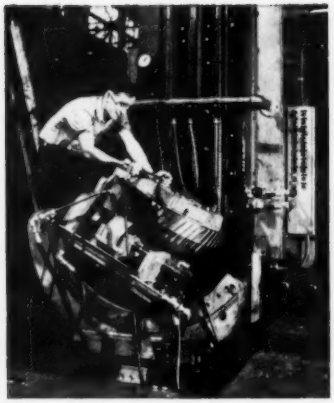
THE ORIGINAL
Electric Welded Pressure Tube

REPUBLIC STEEL

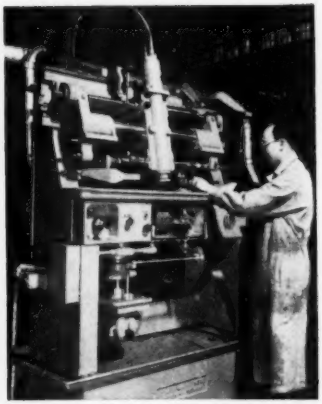
Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

THE ORIGINAL ELECTRIC-WELDED PRESSURE TUBES

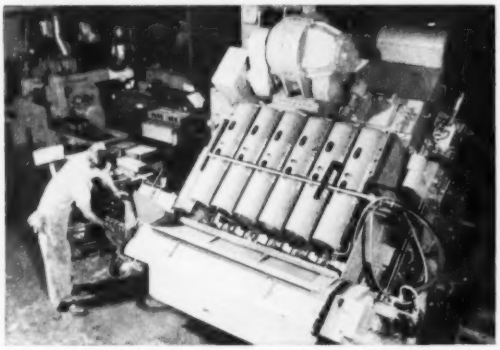
This accuracy check on turbine bucket dovetails is one of many quality controls.



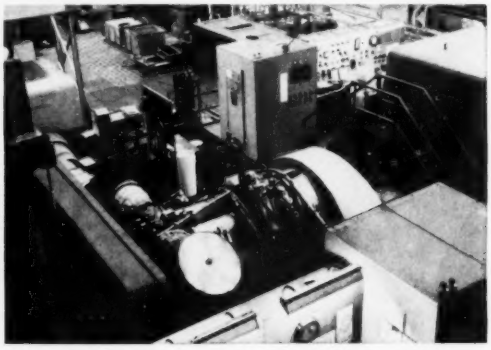
Automatically operated, this three-station broach cuts dovetails in compressor wheels.



An automatic polisher brings machined compressor blades to their final contour.



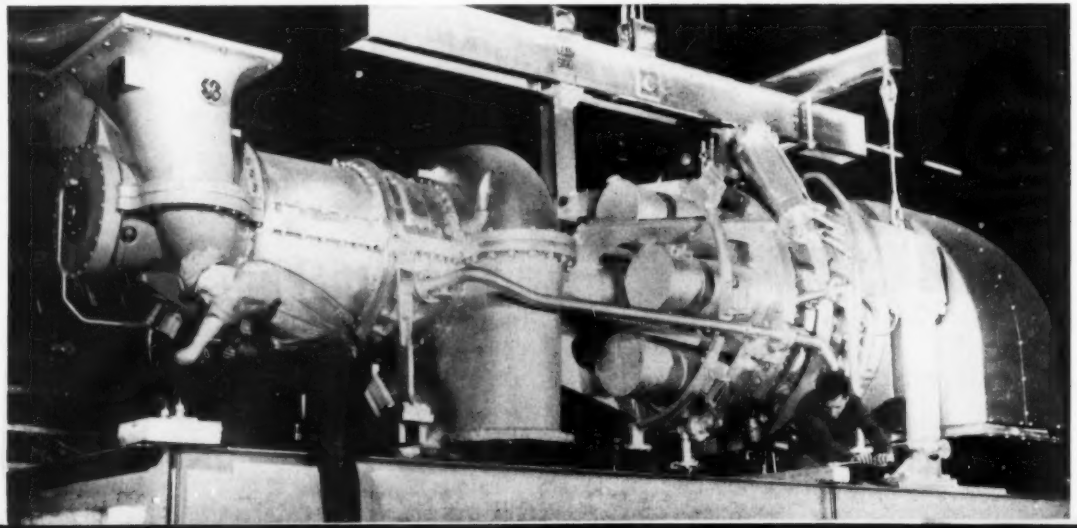
This machine simultaneously cuts six compressor blades or turbine buckets from blank stock to within 0.005 in. of finished dimension.



Testing includes checking of mechanical balance, performance, bearing operation and emergency and speed regulating governors.

General Electric's Gas Turbine Plant

ASSEMBLED UNITS LEAVING THE FACTORY ARE READY FOR PERMANENT INSTALLATION WITH A MINIMUM EXPENDITURE OF TIME AND LABOR.



One of the bays in General Electric's gas turbine plant at Schenectady, N. Y. Units are being assembled for locomotive, pipeline pumping, and power generation service.

Now Tooled for Continuous Production

With the recent addition of a number of specialized machine tools, General Electric's gas turbine manufacturing facilities are virtually complete. Production, testing, and shipment are on a regular schedule in the Schenectady, N. Y., plant. In fact, the 1952 order board calls for delivery of 46 units—six for freight locomotives, 34 for natural gas pumping stations, and six for power generation service in electric utilities. An even larger total will be produced in 1953.

Components for the 3500 kw simple-cycle, the 3500 kw regenerative-cycle, and the 5000 kw compound-cycle designs are in continuous production.

Recently, the first regenerative-cycle machine completed factory tests and is now being installed. This design, distinctive for its flexibility, is suitable for utility application in a variety of arrangements involving the combined use of both gas and steam turbine cycles.

Of particular importance are the refinements in manufacturing procedures which have come about as the result of operating experience with half a dozen units in customer installations. A large fund of data on fuels, design details, and performance has been accumulated.

Thus, in less than five years, a completely new development has become an established product. America's newest prime mover is making a significant contribution to the nation's over-all program for power expansion. General Electric Company, Schenectady 5, N. Y. 255-6

GENERAL ELECTRIC

Eagle-Picher Insulations offer more heat-conserving efficiency per dollar

Eagle-Picher Industrial Insulations are the natural choice of smart-thinking purchasing agents, plant engineers and other executives who are concerned with production efficiency and economy. They rely on Eagle-Picher Insulations to cut costs . . . to provide equipment with the highest possible thermal efficiency . . . to help guarantee precise temperature control.

EAGLE EP PICHER

Eagle-Picher Insulations are top-flight performers every time!

1 **You save time, power and money with this hard-working team* of outstanding insulations:**

Insulating Felts • Supertemp Blocks • Blankets • Loose Wool • Pipe Covering • Stalastic • Insulating Cements • Fireproofing Cement • Diatomaceous Earth Block.

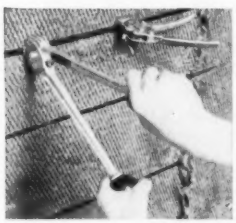
2 **Eagle-Picher authorized contractor-distributors are skilled thermal engineering specialists.**

They can help you control temperatures accurately and efficiently. They know how to help you solve difficult insulation problems.

3 **Eagle-Picher insulations are available where and when you need them.**

Fast delivery is assured by authorized distributors strategically located from coast to coast.

**A typical team of hard-working materials*



Eagle-Picher Mineral Wool Blankets—The answer to the problem of efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured with flexible metal fabric. Outstanding physical and chemical stability for maximum resistance to water, steam, corrosive fumes and normal vibration.

Eagle-Picher Super "66" Insulating Cement—An all-purpose, rust-inhibitive, extra-adhesive insulating cement. Provides great coverage... retains thermal efficiency. Dry coverage, 50-55 sq. ft. 1 inch thick per 100 lbs. Efficient up to 1800 F. Reclaimable where temperatures do not exceed 1200 F. Easily applied on all kinds of surfaces.

Eagle-Picher Insulseal—Protects insulation with a tough, weatherproof coating. For temperatures up to 450 F. Smooth troweling qualities assure uniform coverage, proper thickness. Protects against air infiltration, fumes, rain, snow and vibration... withstands severe all-weather service. Dries to a smooth rich black. Washable.

THE EAGLE-PICHER COMPANY

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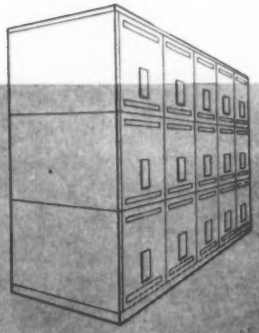
Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request

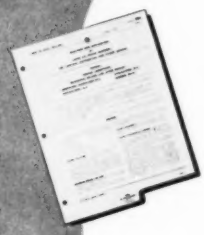
To simplify switchgear problems...plan your



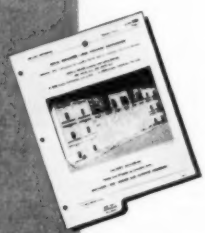
***BEFORE YOU SPECIFY*—SEND FOR YOUR FREE COPIES OF THIS INFORMATIVE I-T-E LITERATURE**

I-T-E Selection and Application Data is specially prepared by I-T-E application engineers to help you through the important steps in planning your switchgear system.

CATALOG SECTION 1003—Comprehensive, illustrated 50-page catalog contains complete data on selection and application of I-T-E low-voltage air circuit breakers and individually enclosed circuit breakers (Urelites).



CATALOG SECTIONS 1104, 1304, 1404, 1504—Detailed description of construction, operation, and application of I-T-E's KA, KB, KC, and LG circuit breakers—and I-T-E's full line of auxiliary and trip devices. Catalogs give you useful tables, wiring diagrams, mounting instructions, and dimensions.



CATALOG SECTION 6004—gives full information on I-T-E Multumite metal-enclosed, low-voltage switchgear. Completely describes I-T-E drawout construction and cubicle design. Contains useful specifications, dimensions, and suggestions for planning your metal enclosures.

FREE

I-T-E CIRCUIT BREAKER CO.
Switchgear Division, Dept. P
19th and Hamilton Sts.
Philadelphia 30, Pa.

Please send me the catalogs which I have checked:

- ☐ Catalog Section 1003
- ☐ Catalog Sections 1104, 1304, 1404, 1504
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NAME_____

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COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE____

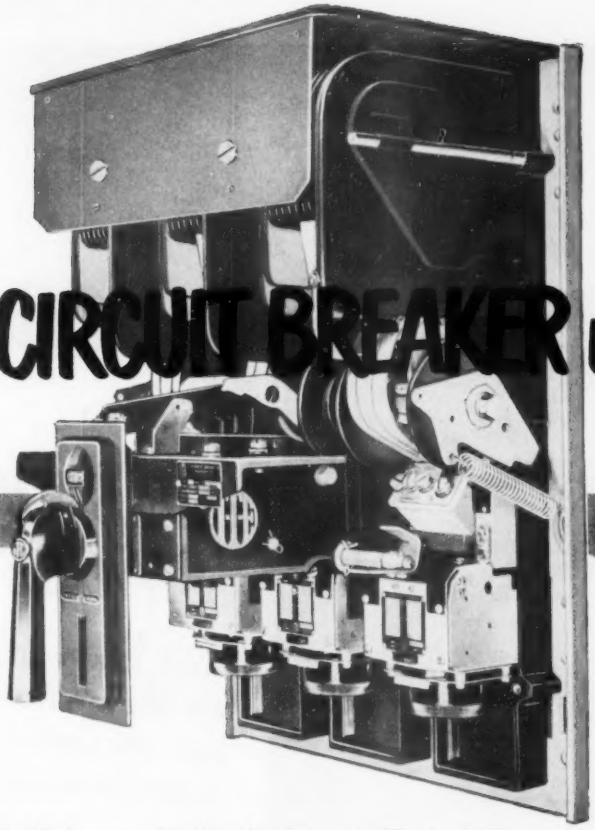
I-T-E

LOW-

I-T-E CIRCUIT

Canadian Mfg. & Sales:

layout from CIRCUIT BREAKER up



I-T-E CAN SUPPLY INDOOR AND OUTDOOR EQUIPMENT IN RATINGS:

15,000 to 100,000 amperes interrupting
600 volts a-c, 250 volts d-c
to 6,000 amperes continuous, a-c or d-c
to 10,000 amperes continuous, d-c only

Expansion or modernization of your electrical distribution system calls for detailed analysis. Before you can properly select your system and equipment, you must consider such important factors as load, power supply, circuits, *protection*, and *reliability*.

This means getting down to fundamentals. And, fundamentally, system reliability depends on *circuit breaker* protection. That's why it pays to think of your switchgear requirements *first of all* as circuit breaker applications.

Follow these three simple steps when planning your switchgear layout. You can then be sure that the circuit breakers you buy will provide the protection you need:

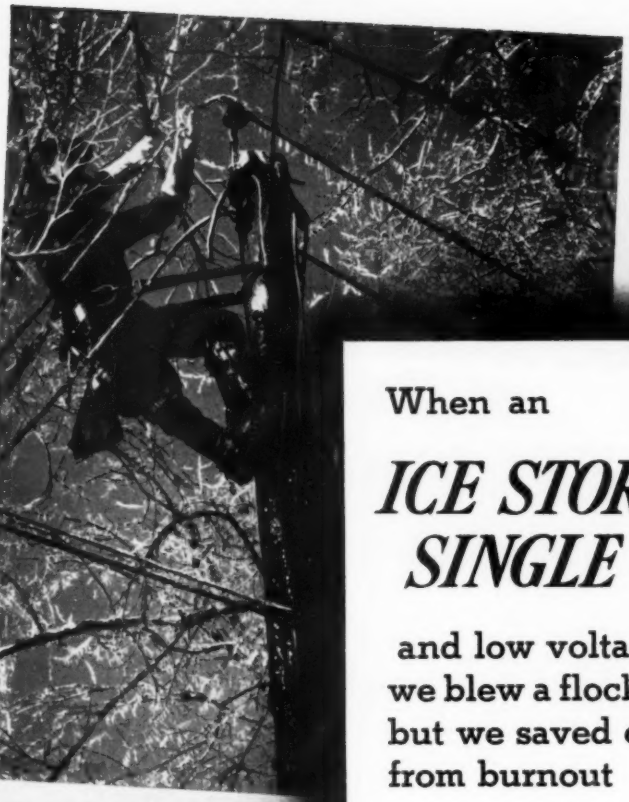
- **KNOW YOUR APPLICATIONS**—their load characteristics, protection requirements, need for continuity of service;
- **KNOW THE CIRCUIT BREAKER** features and functions that will satisfy all application requirements;
- **KNOW THE MANUFACTURER**—his ability to help you solve your problems and provide the best breakers for the job.

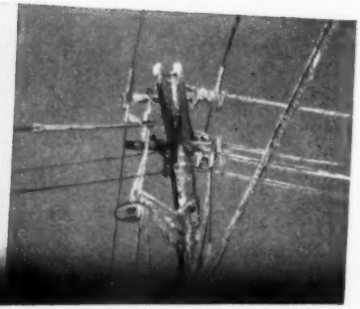
I-T-E experience and specialists are at your service. Your local I-T-E application engineer will gladly work with you on any switchgear problems. Get to know him. Give him a call—*today*.

VOLTAGE SWITCHGEAR

BREAKER COMPANY • 19TH AND HAMILTON STS. • PHILADELPHIA 30, PA.

Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., N. Y. 17, N. Y.





When an

ICE STORM CAUSED SINGLE PHASING

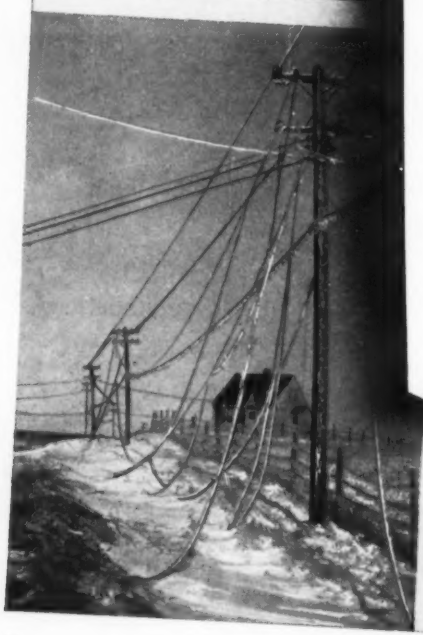
and low voltage conditions . . we blew a flock of Fusetron fuses but we saved over 40 motors from burnout

"For twenty-four hours after the bad ice storm of February 15, 1950 we were endangered by single phasing and low voltage conditions due to the damage done the power lines by the ice.

"During this period, we blew a flock of Fusetron dual-element fuses—around 240 in fact—but we figure that was a very cheap price to pay for saving over 40 motors from burning up.

"After this experience we didn't lose any time in putting all of our plant and equipment under Fusetron Fuse protection."

Michael G. Kupcho,
Master Mechanic
Ashland Shirt and Pajama Company
Ashland, Pennsylvania



You too, can be safe from electrical hazards by using

Fusetron DUAL ELEMENT Fuses

They provide 10 Point Protection

1 •Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

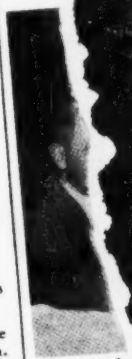
7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

•Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.



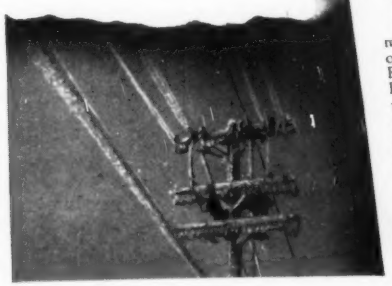
Mitchell Rohde

"Obtaining will not smea... when some on... cement on th... Fluorocarbon t...

FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS



DON'T RISK LOSSES IN YOUR PLANT

Delay may cost you more than replacing every ordinary fuse with a FUSETRON dual-element Fuse — but by passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses, you have action that begets money saving.

SEND THE COUPON FOR MORE FACTS

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

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Company _____

Address _____

City & Zone _____ State _____ 752

(FUSETRON is a trade mark of Bussmann Mfg. Co., Division McGraw Electric Co.)

POWERHOUSE PUMPS

Use This Pump Laboratory

TO STUDY ACTUAL SUCTION CONDITIONS BEFORE CONSTRUCTION STARTS

CORRECTING PUMP SUCTION CONDITIONS after your powerhouse is built can be mighty expensive. You can avoid this danger by testing your suction bay design in this Allis-Chalmers test laboratory.

This unit will duplicate the shape and water flow conditions of your suction bay and show you just how your circulating pumps will operate after installation. You can experiment with the shape and size of the suction bay, test various positions for foundations and pilings, check the effect of adding more pumps at a later date, plot operating characteristics at various loads; in fact, duplicate almost any suction condition that you may encounter in your plant.

Available to Consulting Engineers and Power Plant Operators

The pump testing facilities of the Allis-Chalmers research laboratories are available at the West Allis, Wisconsin, Works to all consulting engineers, utilities and power plant operators concerned with large pump operation. If this pump testing laboratory can help you, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis.

A-3782

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Combined for Service and Savings:

AUTOMATIC CONTROL

and INSTRUMENTATION

by HAGAN

Hagan Engineers have developed automatic control equipment and instruments which can be assembled into coordinated systems designed to meet your particular requirements. For example:

HAGAN AIR-OPERATED AUTOMATIC CONTROL EQUIPMENT includes pressure measuring and control units which may be combined into automatic control systems for process industries, metallurgical furnaces and steam power plants.

HAGAN THRUSTORQ is designed to measure forces and transmit a proportional signal to actuate a recording or indicating instrument, or an automatic control system. Typical applications include: automatic batch weighing, rocket thrust measurement, dynamometer testing of electric motors and internal combustion engines.

HAGAN RING BALANCE FLOW METERS are the most versatile meters available. Hagan Meters indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available to measure pressure differentials from 20" to 140" WC at static pressures up to 15,000 psig, and from 40" to 420" WC at static pressures to 2000 psig.

WRITE, WIRE or PHONE today for information about how Hagan Engineers can help you solve your industrial control and instrumentation problems.

HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

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THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

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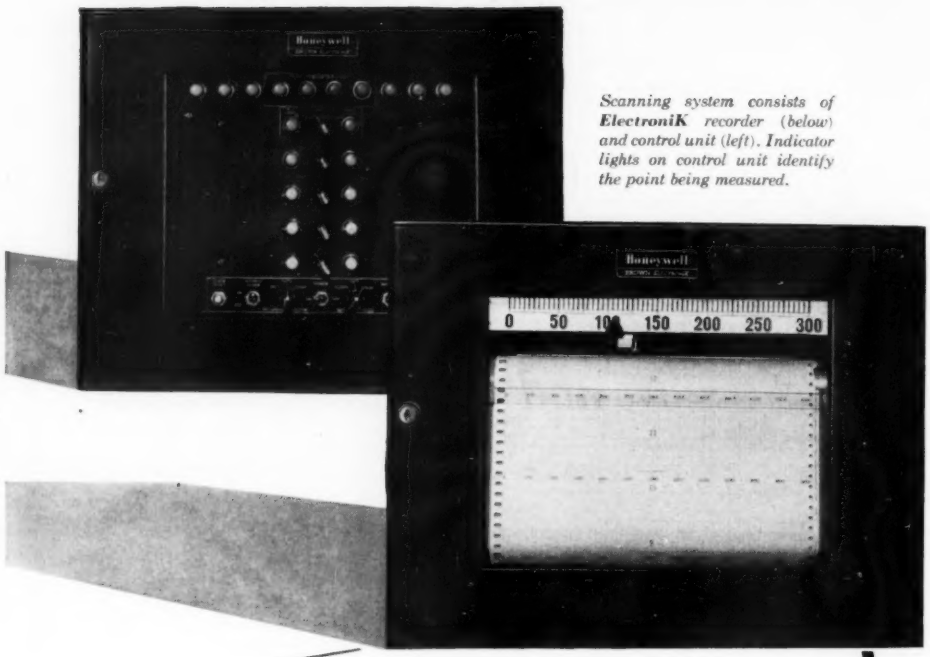


Scanning system consists of ***ElectroniK*** *recorder (below) and control unit (left). Indicator lights on control unit identify the point being measured.*

Versatility and Convenience . . . through these unique features:

Identifies each temperature . . . . Numbered lights signal the thermocouple being measured. Couples are connected in 30 banks of 9 points each.

Flexible Recording . . . . . Choice of four methods: (1) Successive recording of all 270 points; (2) recording only when set point is exceeded; (3) no recording—scanning only; (4) recording only manually selected points.

Individual temperature limits . . . A separate temperature limit, for operating alarms or automatic start of recording, can be set for each bank of 9 couples.

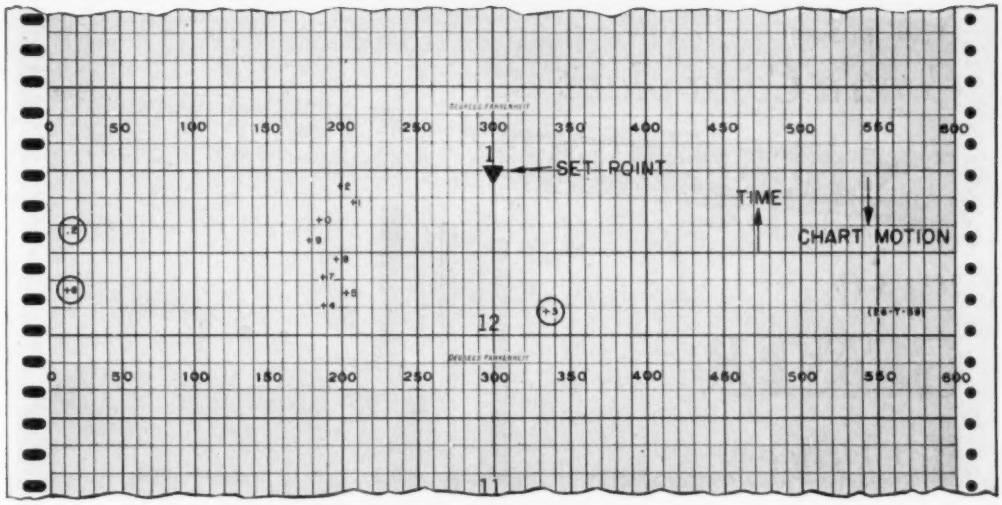
Selective Scanning . . . . . Any bank or banks can be omitted or repeated; choice by selector switches.

Simple Synchronization . . . . . Push-button restoration of proper relation between scanning and printing, if manual operation disturbs synchronization.

Warning Signals . . . . . Operates audible or visual alarms if limit is exceeded by any point.

Fast Scanning . . . . . Average time per point is 1 second, when difference between successive points is 25 per cent of scale span.

Saves Chart Paper . . . . . Chart moves only when instrument is actually recording.



Typical chart record shows how 270 points are recorded on one instrument. Here, point 263 has exceeded the set point. The figures ".2" and "+6" in the left margin identify the first two digits; the last digit, "+3", appears upscale marking the recorded temperature.

Up to 270 plant temperatures *monitored by new* ElectroniK instrument

EVERY power plant has hundreds of potential trouble spots—in bearings, hydraulic couplings, boiler tubes, cooling oil lines—where temperatures should be watched to safeguard equipment and to assure continuous, efficient operation. This new *ElectroniK* instrument affords an automatic, completely reliable means of monitoring these temperatures . . . at unusually low cost per point.

On a single instrument, it can concentrate up to *270 temperatures* . . . bringing them to a single location where operators can inspect them readily. It scans through the thermocouples to which it is connected at a rate of one second per point (when successive temperatures are within 25 per cent of the scale span) . . . checking each point at approximately four-minute intervals. It can perform many functions, at the operator's choice: simple scanning, continuous recording of all points, selective recording, recording of points which depart from specified limits, and operation of annunciator contacts when any point exceeds a preset temperature.

Your savings in labor alone—for manual observation of temperatures and logging of data—will pay for this instrument in short time. And you'll be assured of maximum temperature protection wherever it's needed in your plant.

Ask your local Honeywell engineering representative to discuss your applications for this time-saving, space-saving instrument. Call him today—he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Penna.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

● *Important Reference Data*

Write for Instrumentation Data Sheet No. 10.0-9, "*ElectroniK* Scanning System" and for Catalog No. 90-2, "Supervisory Instruments for Power Generation"

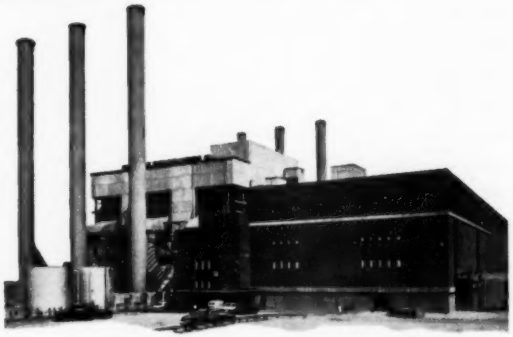
For its
Contra Costa plant

PACIFIC GAS AND ELECTRIC COMPANY

uses a

GRAVER

Hot Process Softener



This utility, like many others in every section of the country, uses a Graver Hot Process Softener for treating the feedwater to high-pressure boilers.

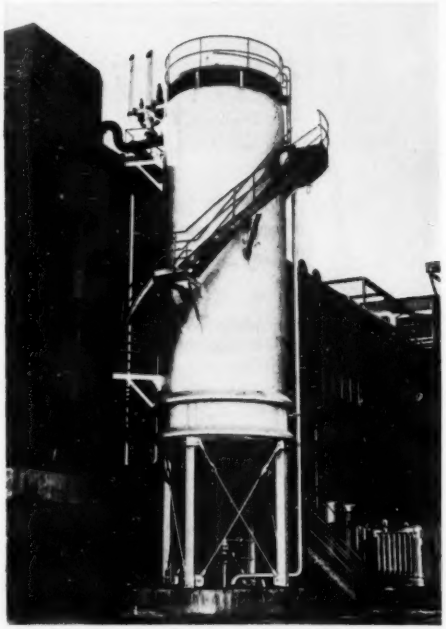
The wide popularity of these Graver units is due to many important advantages.

FOR EXAMPLE:

- **smaller diameter tank for lowest upward settling rate, with resulting economies in cost of tank and installation.**
- **greatest clear settling height, which, together with the low upward settling rate, assures thorough clarification of the treated water.**
- **dual automatic desludging system which protects the boilers from carryover of sludge upon rapid increase in load.**
- **lime feeding system which minimizes deposits in chemical lines.**

In service, Graver Hot Process Softeners reduce both total hardness and silica to the exceedingly small amounts allowable for high-pressure boilers; and clarity of effluent is maintained in many installations *without requiring filters.*

You, too, can depend upon Graver for effective and economical water conditioning. Be sure to consult Graver on your water problem.



Installation of Graver Type S Hot Process Softener for pre-evaporator treatment of 125,000 pounds per hour of feedwater to 1400 psig boilers at the Contra Costa Station of Pacific Gas & Electric Co. in California.

GRAVER **GRAVER WATER CONDITIONING CO.**

Division of Graver Tank & Mfg. Co., Inc.

DEPT. P-H, 216 WEST 14th STREET, NEW YORK 11, N. Y.

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GW 459

POWELL gives
you flow control
at its best!
Advanced engineering, laboratory control of all materials, expert workmanship and over a century of manufacturing experience make Powell Valves what they are today —flow control equipment at its best.
And because they are made to suit the service, there are more kinds of Powell Valves in use today than of any other individual make.
The Wm. Powell Co.
Cincinnati 22, Ohio
POWELL

"Buffalo" Tips on Better

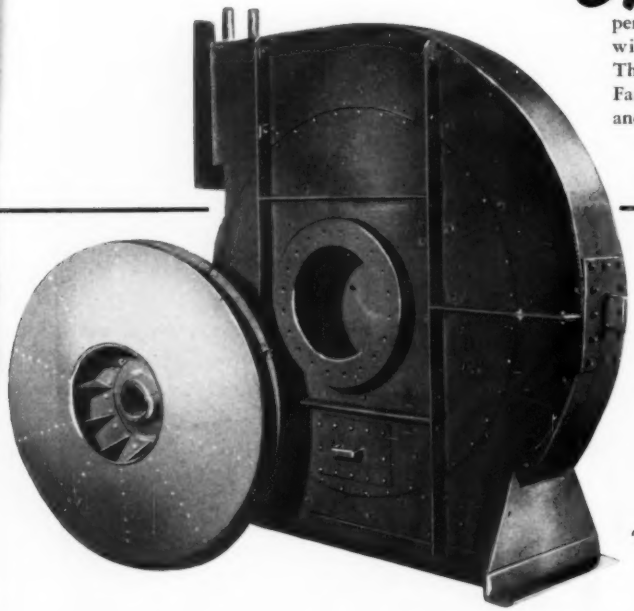
1. FAN FOUNDATIONS ON GROUND FLOOR COST LESS than those high up. If necessary to install high up, supporting steel must be adequate for fan weight, fan rotating effect and concrete pad under fan.

2. GOOD ENGINEERING DESIGN INSURES MAXIMUM SERVICE. "Buffalo" Draft Fans, with their heavy rotors, shafts, bearings and housings, bear this out with their records of endurance on the job in every industry.

3. RIGHT CAPACITY MEANS LONGER FAN LIFE. Too small a fan, overloaded, cannot last, while too large a fan, operating at throttled volume, is inefficient and subject to greater wear and erosion.

4. SPECIFY FACTORY-BALANCED ROTORS. Static and dynamic balance mean freedom from vibration. "Buffalo" rotors are dynamically balanced at the factory on special balancing machines — thus, no time-consuming field balancing is required at the time of installation.

5. SECTIONAL CONSTRUCTION CUTS COSTS. Bolted sectional housings permit servicing or removal of rotor without disturbing duct connections. This accessibility in "Buffalo" Draft Fans cuts both maintenance timeouts and maintenance expense.



"BUFFALO" PRIMARY AIR FAN

Further Helpful Engineering Facts . . .

are yours for the writing, in Bulletin 3750, on draft fans and draft problems. Request your copy today!

DIAMOND JUBILEE 75TH ANNIVERSARY

BUFFALO FORGE COMPANY

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PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

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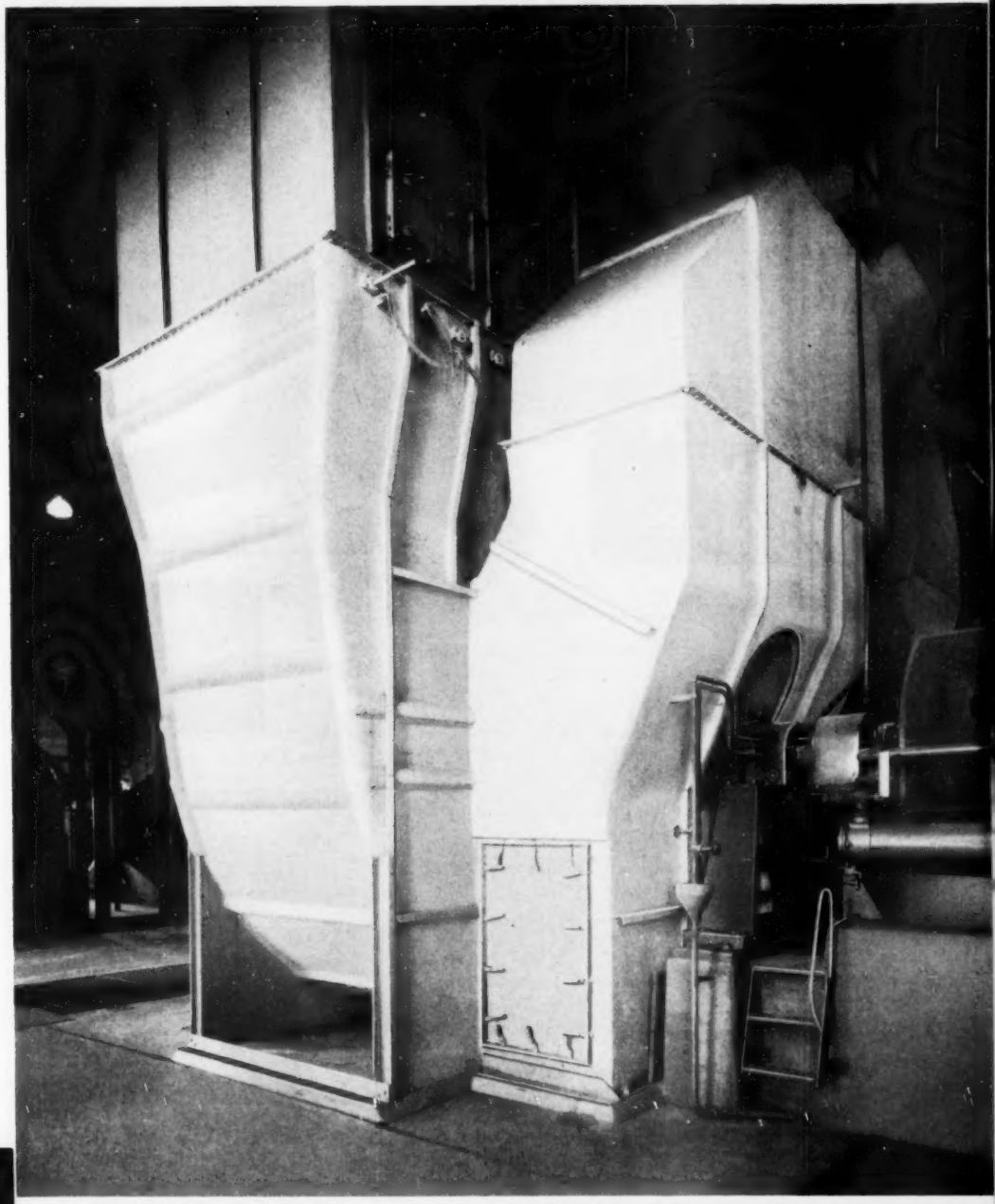
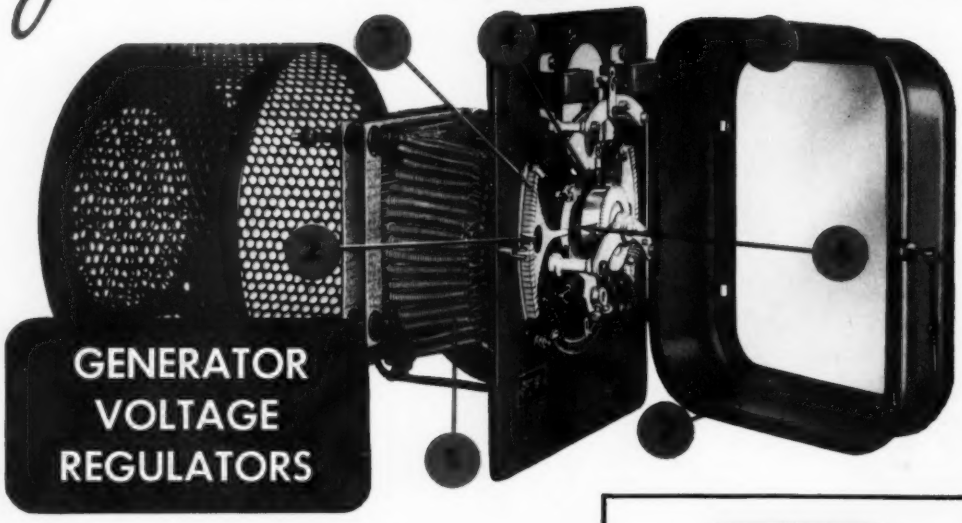
DRAFT Service



"Buffalo" Induced Draft Fan. Note neat insulation and quick opening access doors.

Get Rocking Contact



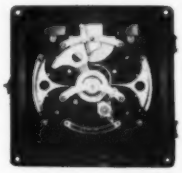
GENERATOR VOLTAGE REGULATORS

With these 7 Features:

- **RESISTORS** are matched to the characteristics of your machine . . . are cut in and out of the exciter shunt field by the *Rocking Contact* sector.
- **SECTOR RIM,** of hard graphite, rocks on the silver-surfaced commutator. This eliminates contact build-up without polarity reversing circuits.
- **COMMUTATOR** is curved so that small sector movement gives quick response.
- **MOTIVE ELEMENT** driving contact sector is fast acting—because of its low inertia design.
- **DAMPING MECHANISM** has no electrical circuits . . . is self-contained.
- **JEWELED BEARINGS** reduce friction, improve sensitivity.
- **DUST-TIGHT COVER** seals out dirt . . . assures lasting accuracy.

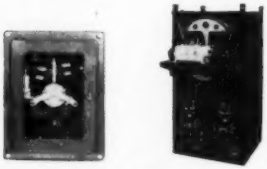
Designed for panel mounting, every *Rocking Contact* Regulator has an instrument-like appearance. Select the one that fits your needs. For further information, call your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3762

Rocking Contact is an Allis-Chalmers trademark.



TYPES A, B, and C (shown in detail above) are applied to ac generators from 125 kva at 257 rpm to 25,000 kva at 3600 rpm. Get Bulletin 14B6035.

TYPES V-00 and 221 Regulators are applied to ac generators from the smallest up to 438 kva at 3600 rpm. Bulletin 14B6143A describes them.

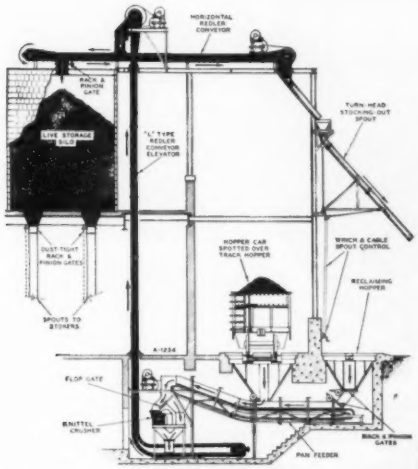


TYPE J, for larger machines, consists of two parts: motor-operated *Rocking Contact* rheostat and a panel-mounted control element. Bulletin 14B6015.

A-C ALLIS-CHALMERS

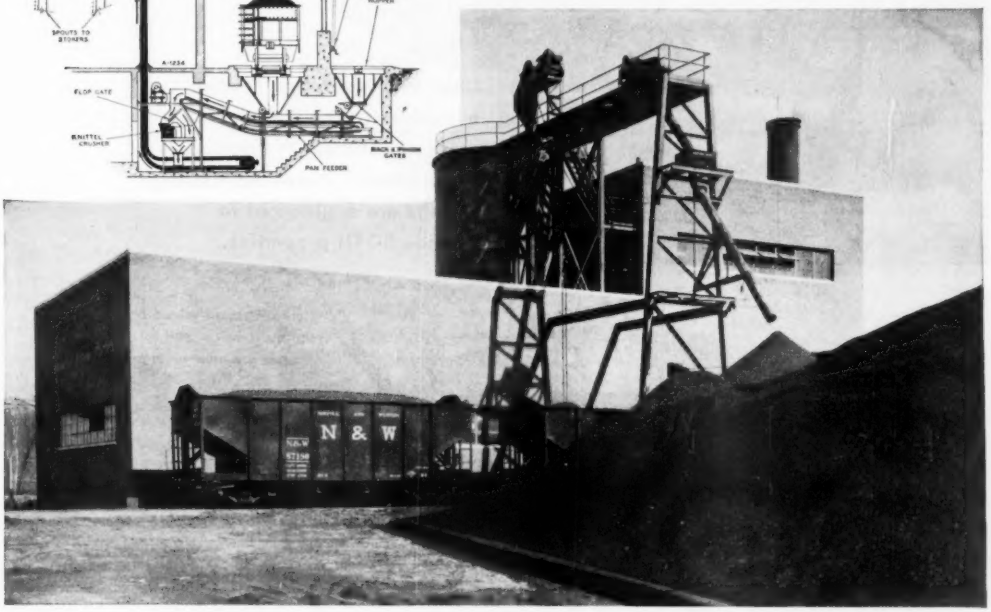
ALLIS-CHALMERS

S-A CONVEYING *Systems* turn complex coal handling jobs into efficient, **low cost operations**



For more than 50 years S-A engineers have been living with coal handling problems. During that time they have successfully met hundreds of specific requirements for the distribution, storage and reclaiming of coal. Whether this called for a simple conveyor unit or a complete system, these installations have done the job efficiently—and always at low cost per ton.

Let an S-A engineer work with *you*. He has a complete line of bulk handling equipment to select from, backed by an engineering organization that knows how to use this equipment most effectively. You can count upon authoritative, unbiased counsel. Write today.



Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll & Ring Type
Bucket Elevators
Gravity Discharge Conveyors
Pivoted Bucket Carriers
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Track Hoppers & Bin Gates
Conveyor Belt Cleaners
Headshaft Holdbacks
Car Pullers & Spotters
TELLEVEL Bin Level Controls
Water Intake Screens
SEALMASTER Ball Bearing Units

Write for a bulletin on any of the above

This compact system receives coal from rail cars, crushes it, elevates it and then distributes it to a live storage silo or to outdoor storage. The system reclaims coal as needed from outdoor storage for delivery to the boiler house. Designed and equipped by S-A engineers, the system includes a REDLER conveyor-elevator and conveyor, a pan feeder and Knittel ring type crusher.

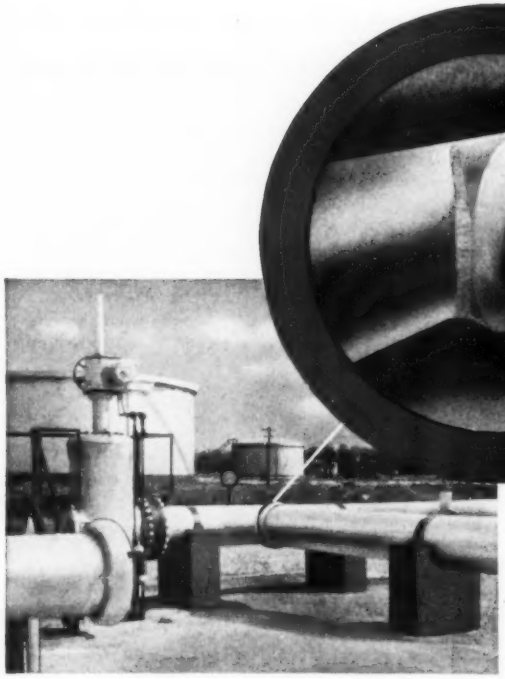
STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

ENGINEERED REINFORCEMENT

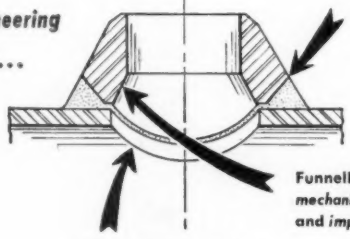
FOR YOUR BRANCH CONNECTIONS



Does your operation require a mechanical as well as a pressure member in branch construction? WeldOlet Welding Fittings are engineered to provide BOTH properties.

A big portion of your engineering job is done for you, if you...

Specify Bonney WeldOlet Welding Fittings to Insure Permanent Strength



Reinforcement where both the mechanical and internal *stresses are most severe*

Funnelled to relieve *mechanical stress concentrations* and *improve fluid flow*

Shaped and beveled for *clean, quick and economical installation*

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W3 WELDOLET CATALOG

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT., 350 GREEN STREET

ALLENTOWN, PENNSYLVANIA

Give Him Power

WHETHER OR NOT you use them all, this man's brains and experience, plus the muscles in his arms, will cost you about $2 per hour. It might seem smart to use all you pay for, but second thought suggests going easy on that muscle.

To see why, let's do a little figuring. First, on the "you've got to work for what you get" theory, you give the worker a hand wrench and tell him to get busy. He does, and turns out what a man unaided reasonably can. Let's call it one work unit per hour.

Next, you tap the till to buy him this electric impact tool. Now he doesnt' work as hard as before, but turns out five work units every hour.

Let's see what has happened. For a liberal guess you charge the tool ½ cent per hour for power and another 1½ cents for wear, tear and repair—two cents in all. Of the five work units total output of man plus powered tool, you credit the man with his one unit and the powered tool with the other four. Then you see that the man's work units cost you $2 each, and the tool's ½ cent each.

Why, then, do sensible people ever use hand tools where a power tool could do the job many times faster? The answer, of course, is that some jobs occur only now and then "so there's not enough work to warrant the investment." Expressed as a general principal, this reasoning is fair enough, but in practice it is much misused. The point where the power tool will pay off comes a lot sooner than most people imagine.

Almost any power tool you can name will speed up work five to ten times or more. That means that from four-fifths to nine-tenths, or better, of the worker's wage is *wasted* for every hour that he works with hand tools where power tools could do the job.

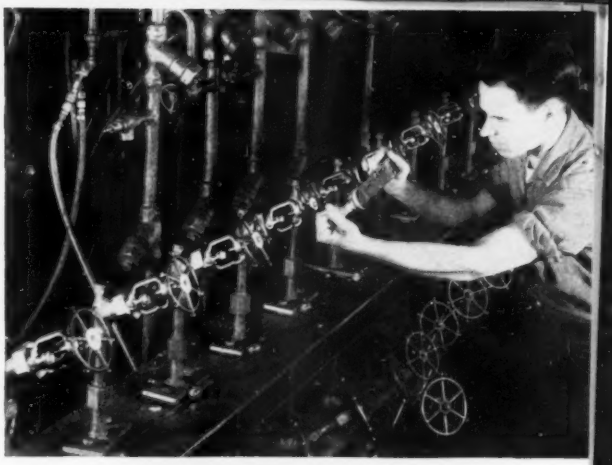
For an interesting exercise, estimate how many hours one of your maintenance men spends using hand tools on jobs that could be done with power tools. Figure four-fifths to nine-tenths of his total wage for these hours over a 2-year period, say. Then see what the total would buy you in the way of topnotch power tools. It will be an eye-opener. And, by the way, don't bother to figure in the power cost; it's only half of one percent.

The above comparisons were inspired by a new program General Electric sponsored. GE calls it "Progressive Mechanization." Powering your hand tools is only the first step, but one of the most profitable. The others, in order as listed by GE, are improved mechanization, automatic control and continuous process.

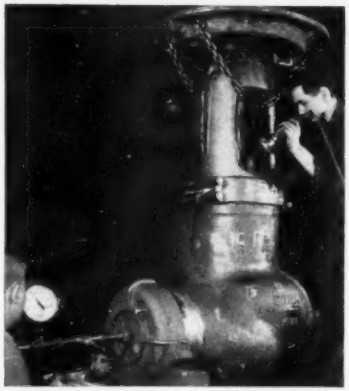
The commendable aim of this program is step-by-step progress in applying more power so human effort can turn out more of the good things of life for all to use.

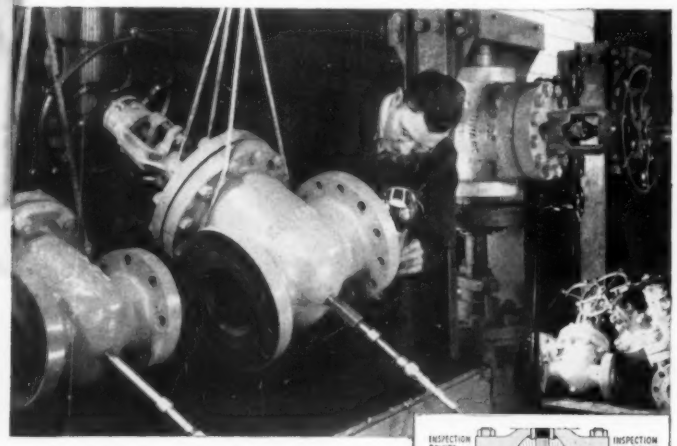
valve values
PHOTO NEWS

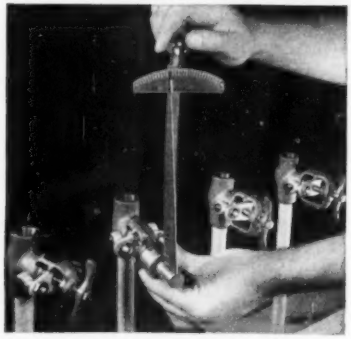
No Exceptions– *Every* *Edward Valve* MULTIPLE TESTED



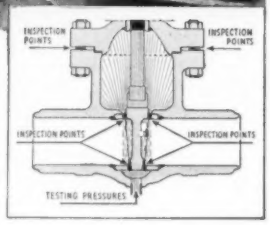
Building components accurately doesn't necessarily insure assembled product performance. Valve tightness, for example, can be established only through rugged testing. And one test isn't enough. Tightness dependability is guaranteed only by multiple testing of every valve—each test designed to prove performance under service operating conditions. For example, the 14-in. PRESSURE-SEAL globe valve (right) designed for operation at 900 psi underwent three separate hydrostatic tests for soundness of pressure containing parts and tightness of bonnet joint and backseat. The Fig. 444 globe valves above, designed for 600 lb, were subjected to a 26 step test procedure including hydrostatic pressure of 3000 psi before receiving an O.K. for shipping release. Every Edward valve from tiny ¼ in. gage valves to largest 2500 lb design must fully meet test requirements. There are no exceptions or tolerances in Edward testing standards.







Many test procedures are exclusive with Edward. Special method of testing gate valve illustrated uses pressure injected through bottom of body to surround seat faces, yet leaves both ends open for inspection. *Both* sides of gate valve wedge must be tight simultaneously to pass test.



No guesstimating in Edward test procedures. Every test condition is controlled by precision tools and instruments. In applying load to handwheels for seat joint testing, torque wrenches are used to precisely measure allowable test torques—only 70 inch-lb to hold 6000 psi for the Fig. 952 valves pictured. Valves must be drop tight at this load to pass test.

Edward Valves, Inc. Another Product

NEW Forged Instrument Valves

FOR HIGHER TEMPERATURES AND PRESSURES

Modern instruments and controls, operating at high temperatures and pressures, require a large cash investment. Sound operating practice demands that these costly devices be protected by small stop valves designed for use at the temperatures and pressures of the fluid being measured or controlled.

Until recently there was no really satisfactory valve for this service. Small threaded bonnet valves were unsatisfactory for high temperature-pressure applications, but were often used because of the lack of a suitable bonnetless valve. Standard globe valves, satisfactory from an operating standpoint, were too bulky for crowded locations such as instrument panels.

For these services, Edward developed its Fig. 952 series instrument valves. Rated for pressures up to 6000 lb at 100 F or for 1500 lb at 1000 F, these all drop-forged steel O. S. & Y. valves completely answer the need for a high pressure, high temperature instrument valve. They are ideal for installations where space is at a premium.

It is impossible to manually damage these ruggedly constructed little valves. Yoke, gland and gland bolts are drop-forged steel for added strength. Drop-forged body eliminates the possibility of pipe seams often found in barstock construction, or internal voids prevalent in thin-walled castings. The vital body-yoke threaded connection, consisting of an external thread on body and internal thread on yoke, is completely outside of pressure area within valve.

FOR EASY PACKING

Simply remove nuts on the two swing gland bolts and position gland on yoke gland rests. Repack valves, as illustrated, with complete freedom of both hands. Generous space between stem and yoke allows quick, trouble-free repacking.

Stem of hardened EValloy, 13% chromium stainless steel, is centerless ground for smooth packing contact. Tapered, needle point disk integral with stem, plus fine pitch stem thread, allow accurate flow adjustment.

Valves are furnished in ¼", ⅜", and ½" sizes in either globe or angle types. Fig. 952-3 valves have carbon steel bodies, while Fig. 2952-3 are furnished with bodies of EValloy, 13% chromium stainless steel. (AISI Type 416 weldable.) Fig. 2952 valves are also furnished in ¾" and 1" sizes. Screwed or socket welding ends are provided.

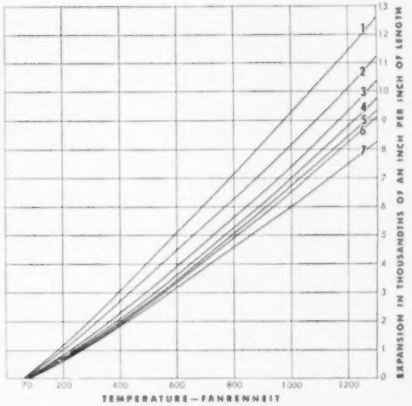
EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
1220 W. 144th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

Technical Tips

What Thermal Expansion Does to Valve Materials

Coefficients of thermal expansion greatly influence the selection of modern valve materials. For example, if the thermal expansion coefficient of a valve stem is greater than that of the valve body, a valve closed tight at an elevated temperature might be less tight as it cooled off, often resulting in leakage. If, on the other hand, the thermal expansion rate of the stem material is substantially less than that of the body material, the stem will contract less than the valve body on cooling, with the result that it may not be possible to open the valve with ease. Ideally, stem material should have a coefficient of thermal expansion only 10 to 20% less than that of the body and bonnet material.



COEFFICIENT OF THERMAL EXPANSION AT TEMPERATURE OF VARIOUS VALVE MATERIALS

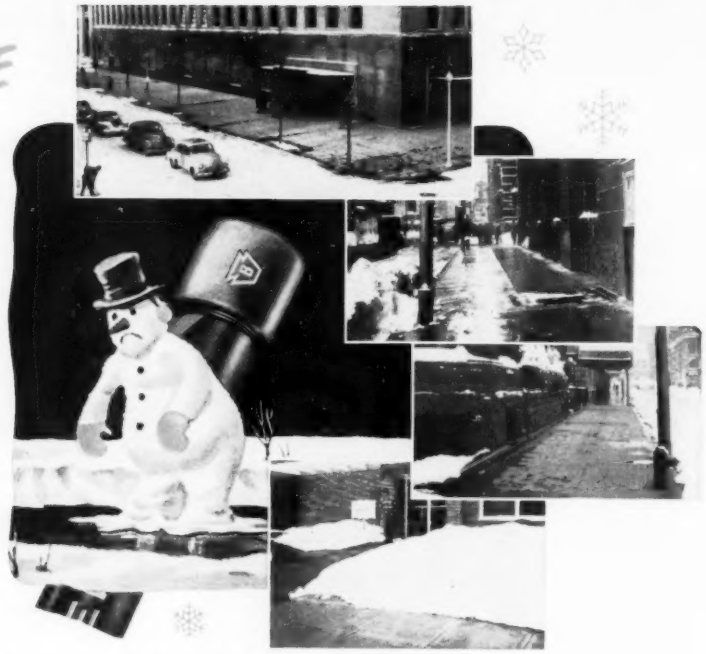
1. 18% Chromium—8% Nickel Stainless Steel valve trim material.
2. Monel—Valve trim material.
3. Stellite No. 6—Valve trim material.
4. A.S.T.M. A216—WCB—Carbon Steel body material.
5. A.S.T.M. A217—WC6—1% Chromium Steel body material.
6. A.S.T.M. A217—WC9—2½% Chromium Steel body material.
7. Edward EValloy—13% Chromium valve trim material.

The chart shows the coefficient of thermal expansion of several valve trim and body materials at temperatures up to 1300 F. Obviously, Edward EValloy meets the ideal thermal requirements for stem materials mentioned above. This, plus its many other desirable properties, make it the most widely used valve stem material.

Hard surfacing is an effective method of imparting resistance to abrasion, galling and corrosion to vital parts of valves. However, cracking may occur if the thermal expansion of the deposited metal and the base metal are different. The chart shows that the coefficient of thermal expansion of Stellite No. 6 is very similar to that of the low alloy valve steels on which it is deposited. This, plus its "red" hardness and resistance to abrasion and corrosion at elevated temperatures makes it an excellent hard surfacing material for valves.

Edward

AVAILABLE NOW!



The first motion picture on SNOW MELTING SYSTEMS

Now, for the first time, you can actually see these modern snow removal systems in operation. In the last few years, a great amount of material has been written and published on snow melting systems, but our new film, "A Winter Wonder," takes you "on location" and shows you how Byers Snow Melting Systems came through recent winter snowfalls in a wide variety of applications.

This professionally-produced film reviews the entire snow melting subject from installation to performance. You'll see how coils of Byers Wrought Iron pipe, embedded in concrete, and carrying hot water-anti-freeze solution, brought hazard-free surfaces to sidewalks and driveways of private homes, commercial buildings, industrial plants, service stations, and many others. In addition to these interesting scenes of "snow melting at work," you'll watch actual operation of installing, welding, and covering prefabricated grids of genuine wrought iron pipe.

Based on the greatest pool of engineering experience on snow melting in existence today, "A Winter Wonder" has been developed as a service to the designer, fabricator, contractor and building engineer. If you share today's widespread interest in snow melting systems, you'll find the practical and factual material in this film both interesting and helpful.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

CUT OUT AND MAIL THIS COUPON TODAY!

Please send me at once:

- ☐ Your descriptive folder on how to apply for a showing of your 16 mm sound motion picture "A Winter Wonder"
- ☐ Your bulletin, BYERS WROUGHT IRON FOR SNOW MELTING SYSTEMS

Tear out this coupon, attach it to your letterhead, sign your name and title and mail to:

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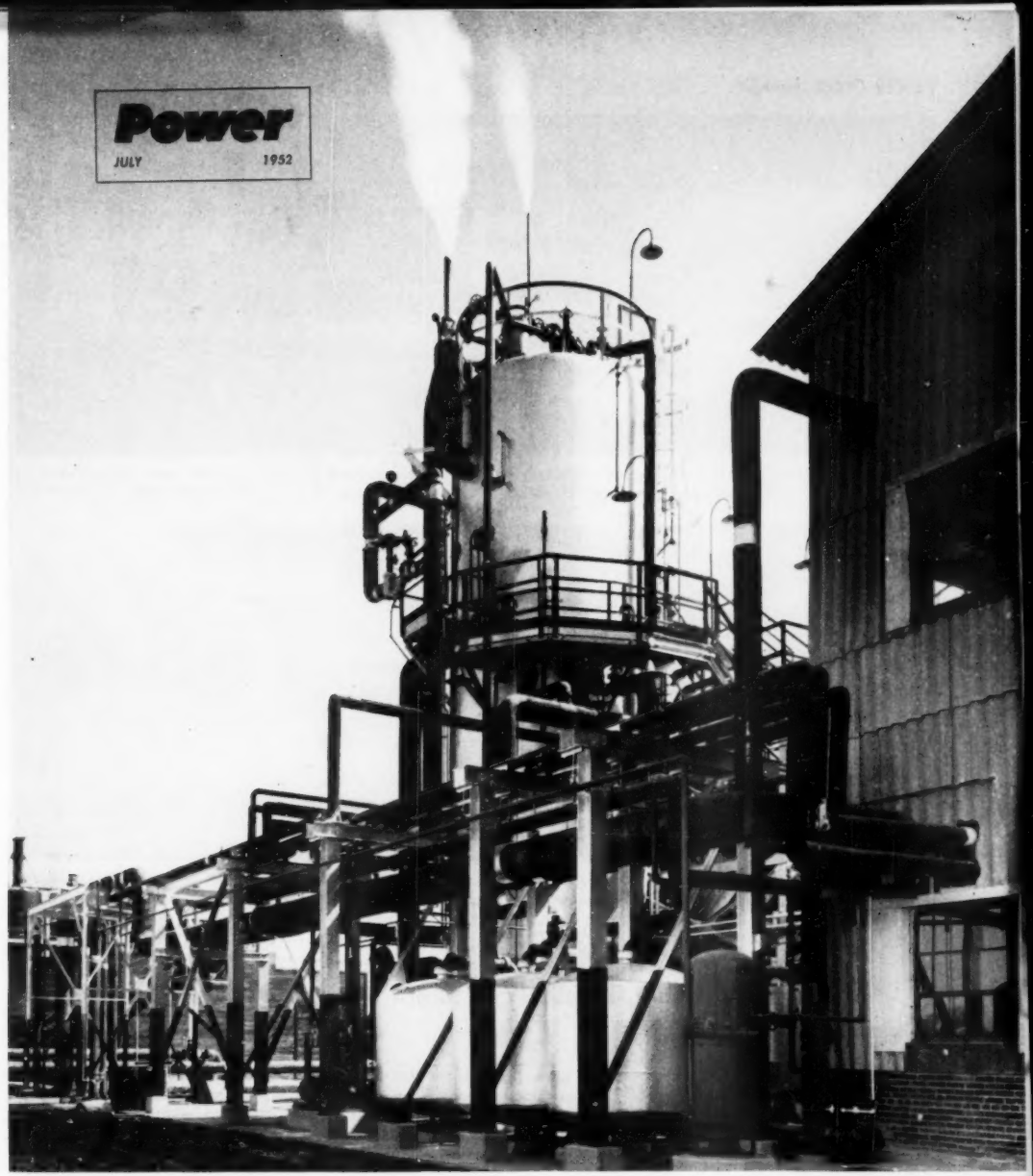
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
JULY 1952

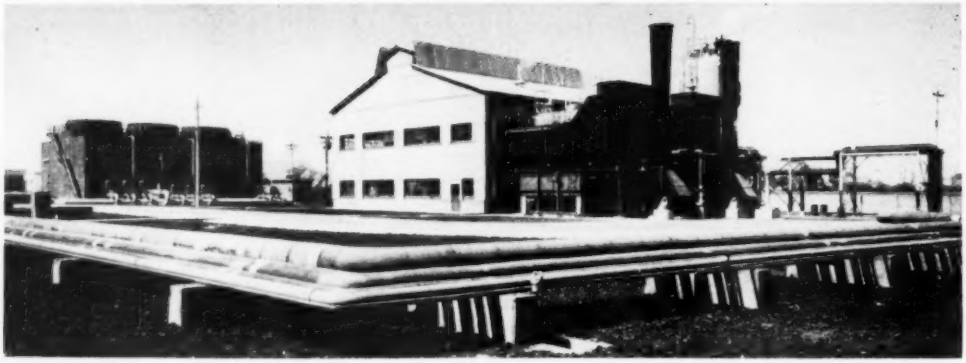


SPECIAL PROVISIONS begin at raw-water intake, carry through to all power services in the typical chemical process plant

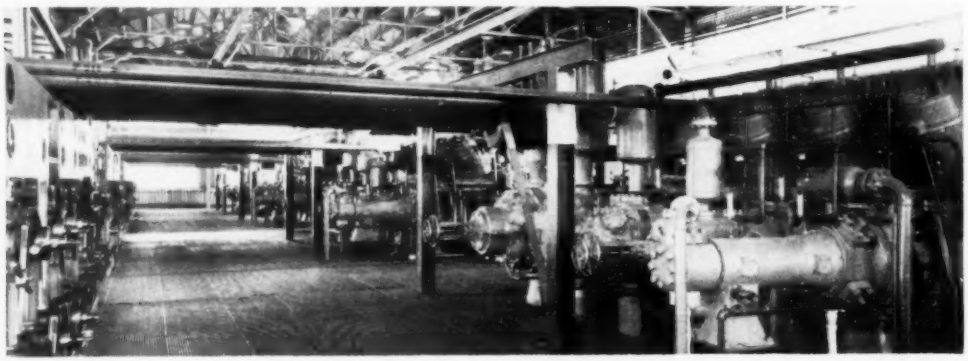
Make the Power Cycle Fit Your Process Needs

JOHN SALVIANI, *Chief Mechanical Engineer, Chemical Construction Corp*

► THE POWER SERVICES, particularly steam and electric energy, make up a high percentage of the over-all cost of raw materials going into the manufacture of synthetic nitrogen fertilizer. So when we (Chemical Construction Corp) put up the Guanos y Fertilizantes ammonium sulfate plant outside Mexico City, we sought a power system with (1) the most efficient over-all heat bal-



PIPING FORMS vital link for steam, water, compressor, air flowing between all the process areas and power plant. Pipes also make possible greater use of condenser cooling water by tying cooling towers into cycle, reusing water over and over



COMPRESSING a mixture of nitrogen and hydrogen from near atmospheric pressure to 5100 psig places heavy demands on power. To meet need efficiently four 875 bhp gas-engines each drive 4300-cfm compressor in the special battery above

For peak reliability, flexibility in power services to chemical processes

ance under all operating conditions (2) a high degree of reliability. The answer seemed to involve combining many central-station features with those giving the desirable flexibility of an industrial power plant.

Steam Needs. We consolidated process steam requirements so they fit into one or the other of two pressure levels, 200 or 25 psi. Electric generators, auxiliary drives for fans and turbines draw steam directly from 430-psi steam manifolds (either superheated or saturated). Other users pull their steam at different pressure levels from the discharge side of pressure-reducing valves or from turbine extraction or exhaust points.

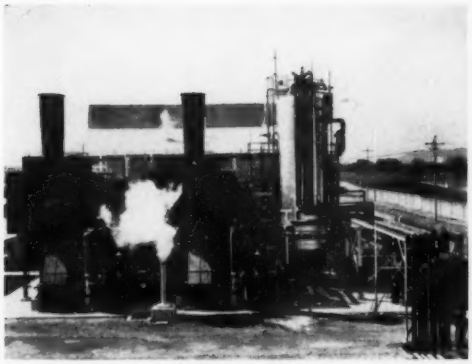
One 430-psi, 750-F, 46,000-lb-per-hr steam generator and one 2500-kw turbine-generator can supply all normal steam and power requirements. But in the interests of greater efficiency and reliability, plus future plant growth, we put in two of each. For the same reason we planned all the main piping so half the plant can be shut down for maintenance and repairs, while the other half runs.

All steam, however, does not come from the main power plant, photo, top of p 72. Instead, we have a waste-heat boiler in the acid plant, 350 ft away, that generates steam at 430 psi, 750 F. This high-pressure steam serves a 500-hp turbine-driven air blower in the acid plant and also ties into the main steam manifold at the power plant. In fact, we use all output from this boiler as our first requirement toward over-all efficiency. Any additional steam needs we meet with the two power-plant boilers.

All high-pressure boilers have saturated-steam outlets for two purposes: (1) steam feed to auxiliary turbine drives on the i-d and f-d fans (2) a back-up supply to a pressure-reducing station for 200-psi needs.

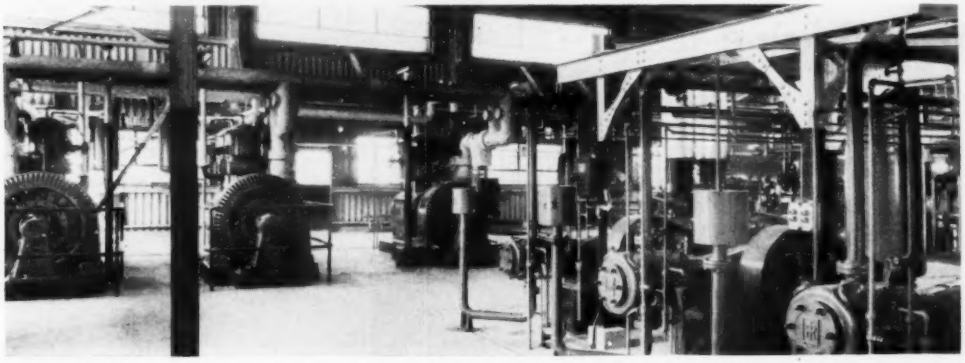
Our process-steam headers draw their supply from an automatic extraction point in the main turbine-generators. This supply level is backed up by a pressure-reducing and desuperheating station in parallel with the turbine-generators.

The Gas-Reforming Plant houses



OUTDOOR construction for boilers and auxiliaries, corrugated-steel housing for turbine room lower power-plant costs

CENTRALIZED controls like these for gas compressors give close check of operation; ease the regular performance tests



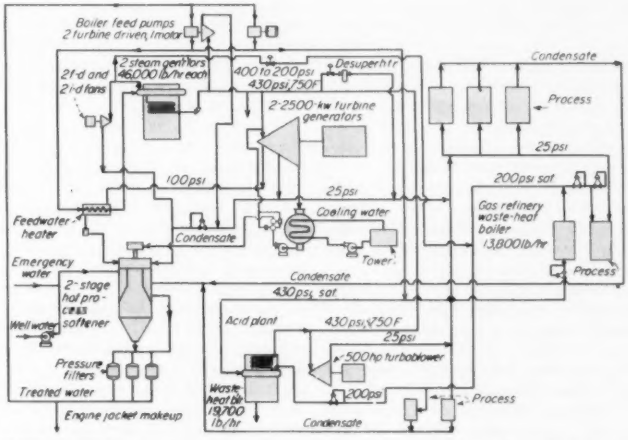
REFRIGERATION capacity plays important part in any process plant, used either directly or as a means of supplying chilled water for cooling. Selection of the best possible drive and application to plant load influence final design

plan your heat balance

two 200-psi waste-heat boilers, drawing, bottom of this page. Their output handles intermediate pressure requirements throughout the area. In exchange for this disbursement of Gas Plant steam we pull a larger quantity of initially high-pressure steam through the turbine to the automatic extraction point and then bleed back to the Gas Plant. As a result we get a high percentage of electric energy as byproduct power.

Water Treatment. Overriding all our steam-cycle operation and layout arrangements is the basic production requirement that waste-heat boilers are critical process tools. Accordingly, we put in all possible controls, safeguards. Water treatment ranks high as a neces-

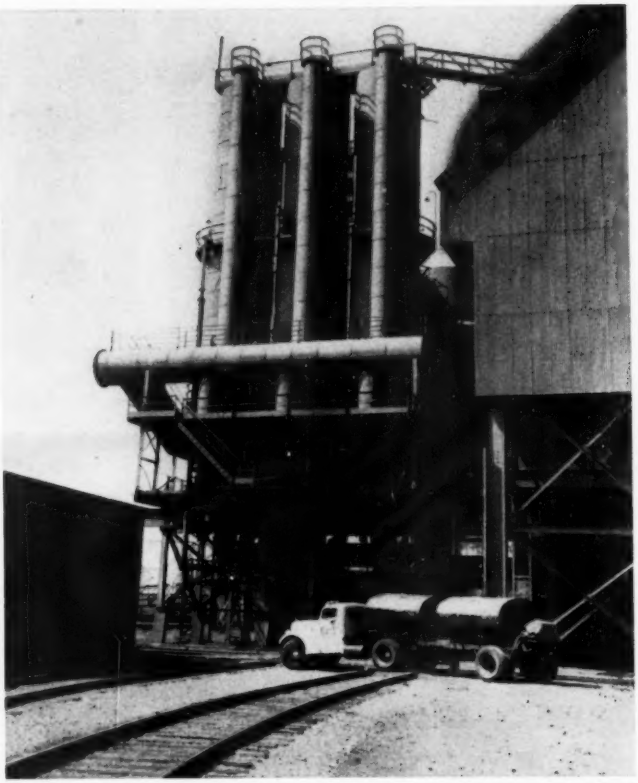
(*Continued on page* 202)



FLOW DIAGRAM traces steam, water cycles throughout the plant, shows how waste-heat boilers, reducing stations, turbine bleeds combine to give utmost flexibility

Competition Brings Down Your Chemical-Cleaning Costs

By C G HAECKER *Solvent Service, Inc*



HERE ARE basic demands chemical-cleaning contractors must meet: equipment equal to the job; engineers, competent, experienced; inhibitor of proper high quality

► CHEMICAL CLEANING of powerhouse and process-heat exchange equipment becomes more attractive the higher production climbs. With it you have the least possible down time, very little dismantling of equipment, considerable savings in manpower, thorough cleaning (see photos, facing page), greater resulting equipment efficiency.

But to get all these advantages at the lowest cost to you means careful selection of chemical-cleaning contractors and a study of competitive bids where possible.

Customer Demands. From your standpoint the contractor must meet three basic requirements—employ a high-quality inhibitor, have experienced service engineers, be adequately equipped to carry out the job.

Inhibitor should be the right one. It should do a highly efficient job and leave the metal free of harmful deposits. There are a number of excellent ones. We know of one, for example, that has a weight loss on mild steel of less than 0.003 lb per sq ft when exposed to 5% inhibited-acid solution for 24 hr at 150 F, with normal exposure held to less than 6 hr.

Next in order of importance is the experience of this contractor's available service engineers. Good experience represents the greatest protection you can give your equipment. The service engineer carries the responsibility of introducing the inhibited acid at proper concentration and temperature into your equipment. Then he has to follow through each step to assure that all details are observed. Things like an adequate soaking period, proper flushing-out, thorough cleaning, correct neutralization to give you a unit ready for service. A failure anywhere along this chain of responsibilities, and your equipment can suffer badly.

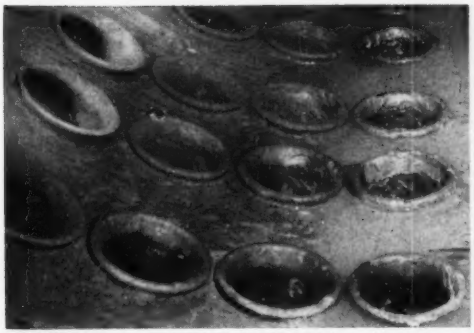
Of equal importance to any other factor in selecting a chemical cleaning contractor is his equipment. Be certain he can furnish acid-cleaning equipment large enough to do what you need.

Contractor Aids. If you expect intelligent competitive bids for acid-cleaning, take a page from your own book on getting prices for other plant needs. You know the better you spell out your wants, the closer the prices will be. Here's the kind of information you can give an acid-cleaning contractor to help him give you his lowest possible bid:

1. *Description of equipment.* If it's a boiler, for example, give manufacturer steaming capacity in lb per hr or even in boiler horsepower; design type, that is, water or fire tube; if water tube list the number of drums.

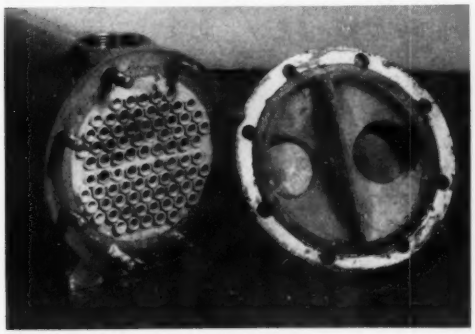
2. *Water volume.* Again, for a boiler, you need the volume to the steaming level or top of the drum, depending on how high you want the unit cleaned. This quantity is most frequently lack-

Acid Cleaning Is Thorough, Requires Little Dismantling

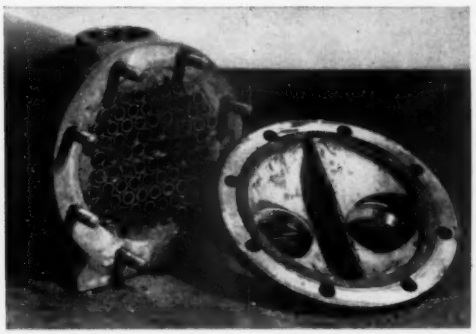


BEFORE Drum and tubes of 250,000-lb-per-hr boiler get to look like this after they've been in service

AFTER Acid that is properly inhibited leaves the boiler tubes whistle clean, while surfaces are unharmed



BEFORE Oil coolers develop doughnut scale on the tube ends that badly restricts the normal flow of oil



AFTER Proper chemical-cleaning procedure clears the surface completely. Back on the line again in 36 hr

ing and the burden of estimating it often falls on the contractor. Compute the water volume of your unit accurately once and then keep it on file. Occasionally you'll find the boiler manufacturer gives the weight of the boiler full and empty to determine floor loading. The difference will give you the water volume in pounds.

3. *Scale sample.* Where possible provide bidders with a half cup of scale sample along with an estimate of the average scale thickness. This allows the contractor to test scale solubility, disintegration, chemical content, and to determine cleaning-solvent concentration, best working temperature. With no available sample, give the source of water supply, type of water treatment, any other data that will help in determining the scale solubility.

4. *Number of units available.* Remember, one of the contractor's greatest costs is getting to the job site. Frequently you can clean other units at the same time for the cost of additional material only. By sending trucks with full instead of partly full tanks, and by having labor work on other equipment while the first is soaking, the owner gets these additions at almost no cost.

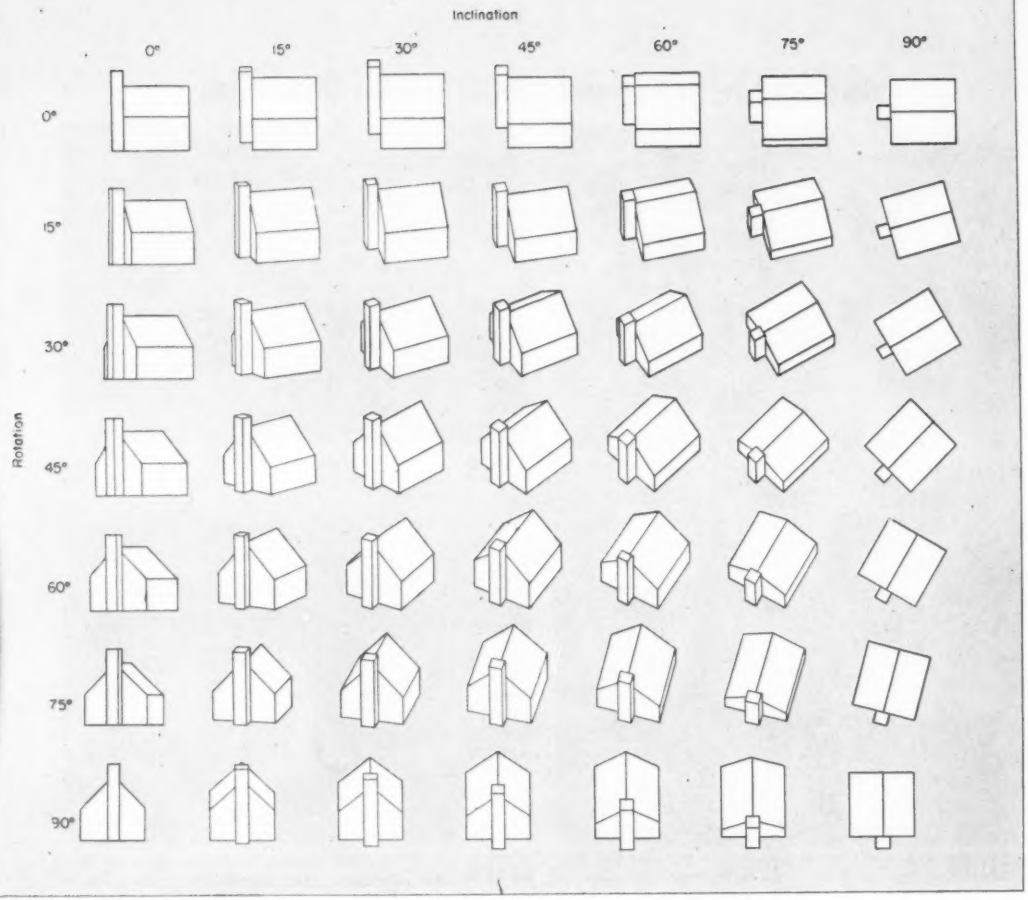
5. *State desirable date.* Where possible ask the contractor to bid well in advance. Then grant the successful bidder all the time you can so he can schedule equipment, materials, labor. If all your cleaning jobs are emergency ones, you may be footing a heavy extra cost. In any event it's smart to obtain time and material rates from qualified contractors.

6. *Cost outlooks.* Wide differences in bid costs may indicate sharply different approaches to your job. For example, the low bidder may ask you to supply steam and water piping to his truck for heating and diluting the solvent. Today, with the portable heaters now in use that's not always needed. Other bidders may have this equipment and their bid include it.

Where you'll use a quantity of solvent, be sure the concentration is stated. Otherwise, you may be buying a lot of water. But be careful that you leave the responsibility where it belongs, with the contractor.

A smart outfit cleaning, say, an evaporator dumps concentrated solvent into the unit already filled with hot water to save the costs of heating, diluting and installing steam and water lines to chemical-mixing truck, as well as supply and circulating lines to evaporator.

Summary. It is our opinion that chemical cleaning is rapidly leaving the specialty classification and becoming generally applicable because of its lower costs. Requesting competitive bids from qualified contractors, who are equally informed of your wants, will help push these costs down still further.



1 Trimetric drawings can show an object from any viewpoint. Some of them are the conventional plan and elevation views shown in corner sketches. Most useful views often show two or three planes at same time, look much like perspective drawings

How to Make Trimetric Drawings

By B G A SKROTZKI
Associate Editor

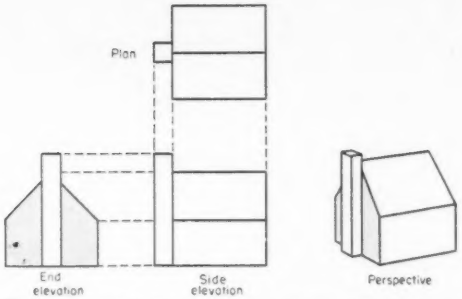
► ONE PICTURE is worth a thousand words—an old saw. But have you ever thought how much effort goes into making one picture? Sometimes it seems easier to write the thousand words. Trimetric drawing gives us a quick method of making pictures, easy to look at and understand.

Easiest picture to grasp is the perspective drawing, Fig. 2. Unfortunately it's the hardest to draw—many of the construction lines usually run way off the paper and it takes considerable time to spot the needed points properly. Trimetric sketches are the nearest to perspective in appearance. But since lines, actually parallel in space, stay parallel in sketches, the drawings appear distorted. To the eye, such lines actually seem to converge, coming together at the horizon line. Despite this, trimetric sketches are practical, finding many uses in industry.

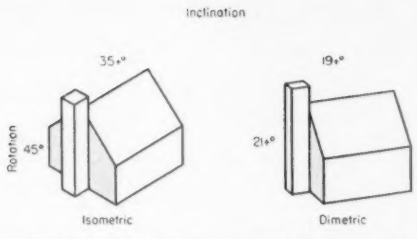
Fig. 2 shows the perspective of a simple, everyday house shape and the corresponding orthographic projections or working drawings an engineer uses to describe the house. The working drawings ordinarily carry dimensions in addition to being drawn to a uniform scale, one inch equaling so many feet. Many people just can't see the shape from the plan, end and side elevations, but they instantly savvy a perspective or its near relative, the trimetric.

Trimetric drawings are really orthographic drawings. The latter usually include only those views of an object that are kept parallel to the plane of the paper. In trimetric you can place the object at any angle to the paper so you see two or three sides of the object simultaneously.

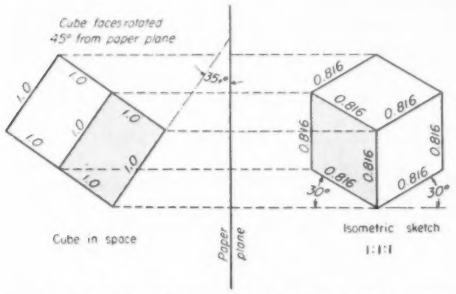
One of the most used forms of trimetrics is the isometric. In this special case the three space dimensions or axes are drawn at 120° to each other and a given length is equally long on all three axes. Fig. 4 shows how this isometric view is derived from an actual object in space. At the left is a cube in space,

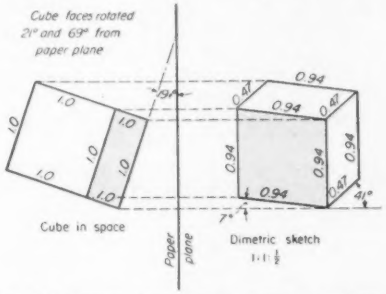


2 Experienced engineers can interpret conventional plan and elevation drawings to see perspective appearance mentally



3 Isometric and dimetric sketches are most often used of trimetric drawings. Isometric is easiest to lay out and scale





4 These sketches show relation of actual cubes in space to plane of paper on which isometric and dimetric views are drawn. Note that angular placement in space is different from angles used in drawings, a frequent misunderstanding

each edge one unit long. Cube is first placed so each of two adjacent faces nearest the plane of the paper makes a 45° angle with the paper surface. The cube is then tipped so the vertical edges make about a 35° angle with the face of the paper. Projecting perpendicular lines from the face of paper to corners of cube we can spot corresponding points on the paper. Connecting them we get the diamond-shaped figures that we recognize as an isometric sketch of a cube, shown to right of line representing the paper plane. We find the edges are all 0.816 times the length of the original edge and the sloped lines make exact angles of 30° with the horizontal. In practical usage we forget about the 0.816 ratio and proportion the distances directly to dimensions of the original.

Another useful special case of trimetrics is the dimetric sketch, also shown in Fig. 4. Here, of two adjacent cube faces, one is rotated to make about a 21° angle, then the other is about 69°, with the plane of the paper. The cube is then inclined so its vertical edges make about a 19° angle with the face of the paper. Projecting the cube corners onto the paper and connecting them gives us the dimetric sketch shown to right. Vertical and longer sloped edges are each 0.94 times original length, and the sharply sloped edge is 0.47 times the original length, just one half of the other two dimensions. This makes a scale proportion of 1:1:½. Angle of the longer slope is a little more than 7°, and the shorter a little more than 41° from the horizontal. Again we forget about the 0.94 and 0.47 ratio and proportion the lines directly to the original dimensions taking proper account of the 1:1:½ ratio. Angles are drawn to the round figures mentioned.

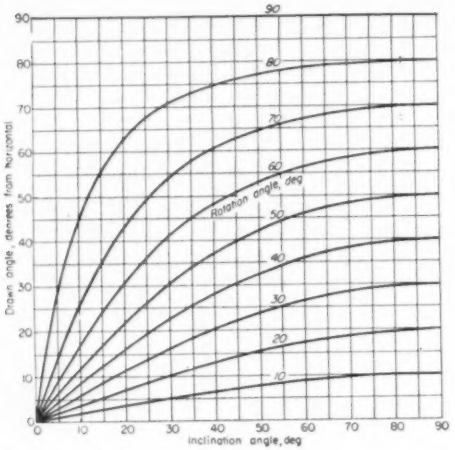
Fig. 3 shows the house of Fig. 2 drawn in isometric and dimetric. Each gives a different viewpoint. By selecting either as a standard we are committed to a fixed view angle. Now, the general use of trimetrics allows selecting any viewpoint you want, Fig. 1. Corner sketches you'll recognize as the standard orthographic drawings of the house. The others show two or three planes instead of only one.

From left to right, viewpoint varies as vertical lines of house are inclined in 15° steps with the plane of the paper. From top to bottom, viewpoint changes as house is rotated around a vertical axis in 15° steps. Comparing Fig. 3 with Fig. 1 you're able to spot where the isometric and dimetric views fall in the general scheme.

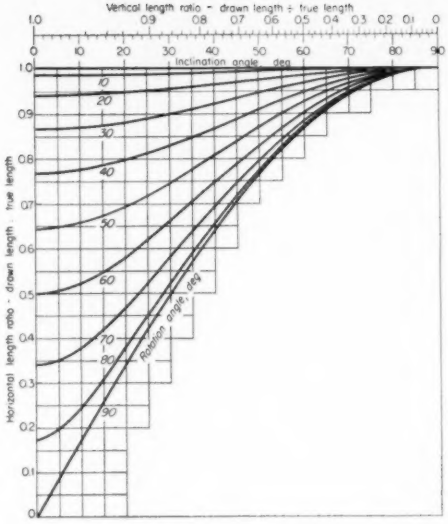
How are these sketches drawn? Very easily, with the aid of Fig. 5 and 6. First, choose the inclination angle you wish to use, say 20°; then the rotation angle of one of the principal faces of the object, say 30°. So we enter Fig. 5 at 20° on the horizontal axis and read up till we find the 30° rotation angle curve. This tells us to draw the edge for this face of the object at an angle of 11° from the horizontal, measured with a protractor. Now to find the comparable angle for the other face, subtract the 30° rotation from 90°, giving 60° rotation for the other plane of the object facing the paper. Again entering Fig. 5 at 20° inclination, find that the 60° rotation calls for a drawn angle of 30.5° from the horizontal. The third axis is always vertical. These three axes can then be drawn as in Fig. 9.

Next we must find the scale of each axis; this is where Fig. 6 comes into play. Enter at 20° inclination angle and read down to the 30° rotation curve to find a ratio of 0.881 for this face of the object. The other face at 60° rotation has a length ratio of 0.58. Then we find the ratio for the vertical lengths.

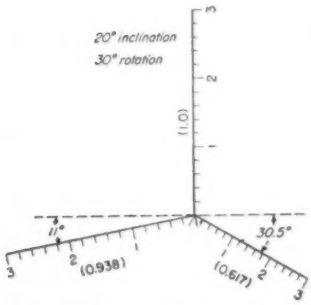
TRIMETRIC DRAWINGS *continued*



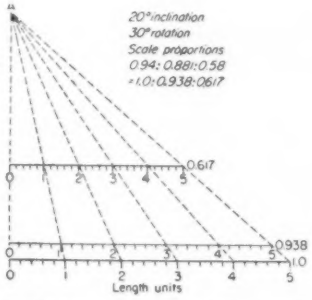
5 This chart gives the angle of slope from the horizontal of lines in space having given inclinations and rotations



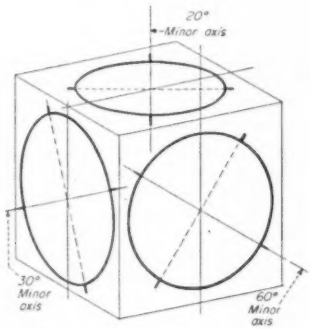
6 This chart gives the ratio between drawn and original lengths for the lines with given inclinations and rotations



9 In general case of trimetrics each axis has different scale proportion



10 Relative scale lengths for trimetric axes can be made quickly in this way



11 Easiest way to draw ellipses on trimetrics is to use ellipse templates

This is actually the cosine of the angle of inclination; use a trig table or the adjacent scales in top of Fig. 6. Ratio for 20° inclination is 0.94. This gives us scale ratios of 0.94:0.881:0.58. Or referring to the vertical axis as a base, proportions are 1.0:0.938:0.617.

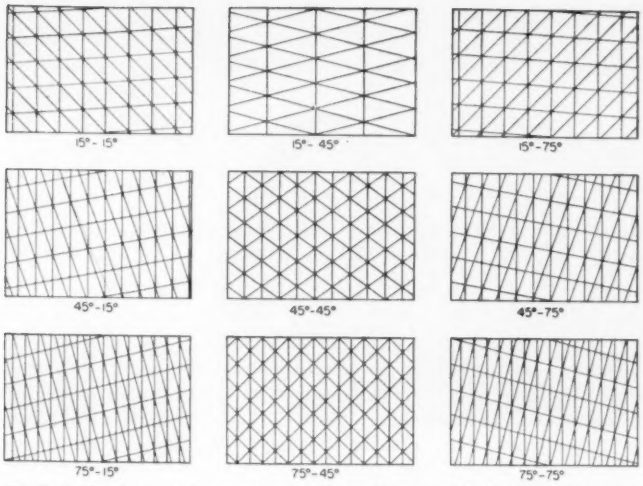
Rather than multiply each dimension of your original by its corresponding ratio to determine the drawn length, it might pay to make up scales for each axis. After deciding the size of your drawing, lay out scale for longest axes corresponding to the ratio 1.0 on stiff paper, Fig. 10. From any convenient point *A* on a perpendicular above the 0 of the unity scale, draw a construction line (dotted) to other end of scale. From the perpendicular draw lines parallel to the bottom scale that have corresponding lengths of 0.938 and 0.617, to meet the right-hand construction line. Then by construction lines radiating from *A*, calibrate the two shorter scales, using the graduations on the longer one as a guide. Cut out the scales along the straight edges and they're ready to use as indicated on Fig. 9.

Grids. When you do a large amount of sketching with given inclination and rotation, it pays to make up a grid. Placing this grid under transparent drawing paper speeds up the job. Fig. 7 shows nine different grids as examples. Angles are determined from Fig. 5 for the given inclination and rotation. Spacing between lines is arbitrary; place them close enough to suit your convenience. Note that grids with 15° and 75° rotation (complementary angles) are mirror images of each other.

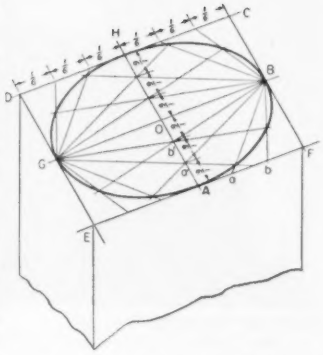
The only grid on which spacing between lines means anything is the isometric, which is 35°-45° (it appears similar to the 45°-45°); grid consists of connecting equilateral triangles where distances between intersections along any line are equal. This corresponds to the 1:1:1 proportion of the isometric.

The dimetric grid appears similar to the 15°-15° and 15°-75° grids of Fig. 7. Distances, though, must be measured by separate scales. Grid spacing is no help on the dimetric in laying out proportional lengths.

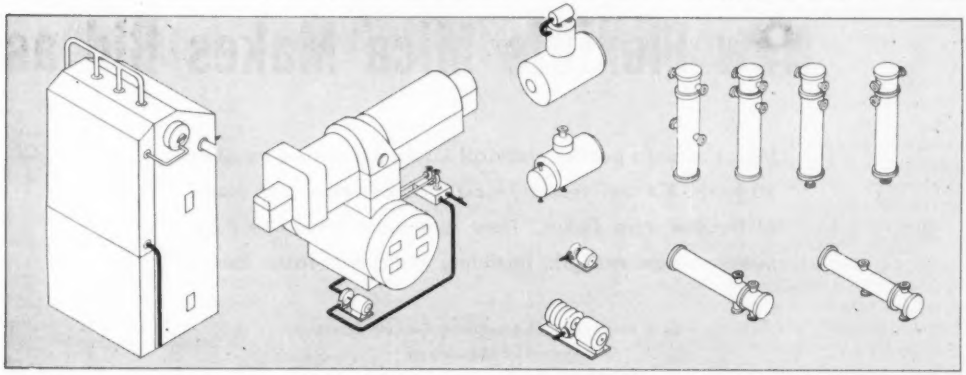
Circles on trimetric surfaces appear



7 Grids like these samples speed up job of making trimetric drawings when a lot of work is to be done with given system of inclination and rotation angles



8 Here's the basic construction needed to lay out an ellipse for trimetrics



12 When many alternate layouts of plant equipment are to be studied isometric sketching can be a big help. Patterns like these can be drawn to scale and duplicated as needed by photostating. Use by cutting out and laying over scaled grid

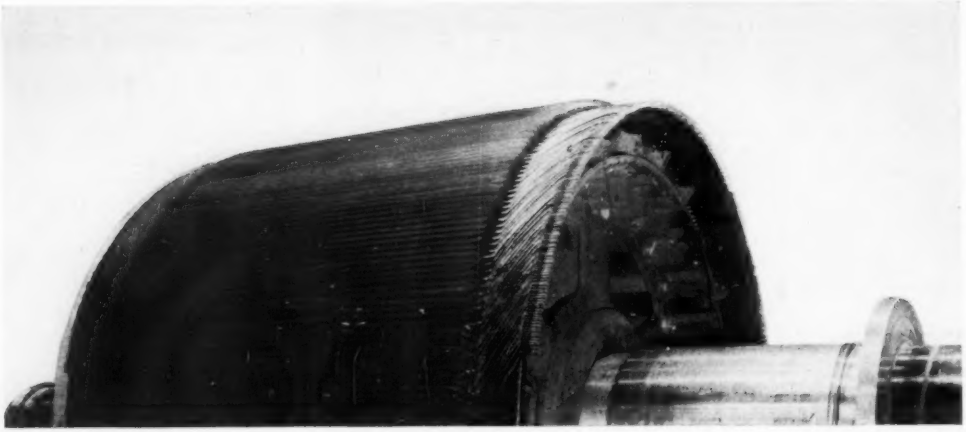
as ellipses. These are most conveniently drawn with the aid of ellipse templates. The templates are numbered according to angle of inclination or rotation, or the complementary angle—depending on manufacturer. Fig. 11 shows a cube with 20° inclination and 30° rotation having equal diameter circles on each face. To get the circles (ellipses) properly centered, find center of each cube face. Through centers erect a line, apparently perpendicular to the face (these are actually parallel to one of axes.) These "perpendiculars" are the minor axes of the ellipses. On the templates, minor and major axes of the ellipses are shown by tick marks on their circumference. Place tick marks of the minor axis to coincide with the "perpendicular" and an imaginary line (dotted) from the major-axis tick marks to pass through the center of the circle.

When you don't have a template, the ellipse can be drawn by method in Fig. 8. First lay out CDEF the circumscribing "square" for the circle and one diameter *AH* parallel to short length *DE*. Divide *AH* into a convenient even number of parts, then divide *CD* and *EF* into same number of sections. From *B* and *G* draw lines to intersect the division points as shown. Intersections of these straight lines locate points on the ellipse. Connect these points with aid of a French curve.

Hookups. Trimetric drawings are used to advantage when many alternate hookups must be studied. Fig. 12 shows some basic power-plant equipment elements drawn in isometric. Drawn to a common scale these can be photostated to produce as many duplicates as needed.

After cutting them out you can arrange them in alternate ways over an isometric grid to represent their physical relation in space. After pasting them in position, draw in connecting pipe lines to scale.

You can use this scheme with any trimetric set of conditions. Choose the set that gives the best viewpoint. This procedure has the advantage of simulating a perspective drawing, but in addition direct measurements can be taken off these sketches which can't be done on a perspective view.



UNIFORM THICKNESS, high dielectric strength of new paper-like mica makes it well suited for this 4000-hp 40-rpm 900-v dc armature. Silicone bonding with glass-cloth backing can be incorporated to reach the higher temperature limits

New Flexible Mica Makes Bid as

Mica has been part of electrical insulation picture for over 50 years. But until recently most such insulation was made of bonded mica flakes. New continuous paperlike mica raises voltage strength, flexibility and power-factor range

By R W WIESEMAN, *Large Motor-Generator Engineering*
General Electric Company

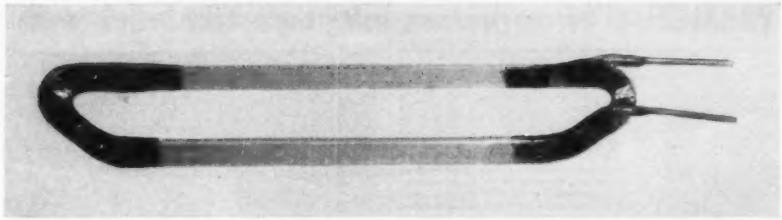
► ARMATURES rated over 7000-v generally have mica-base Class B insulation. So far no basic material can surpass the insulating qualities of mica for armature windings. Good-quality mica flake has the highest voltage strength, best heat and corona resistance. And when properly processed, mica insulation offers topnotch moisture and insulation resistance, plus favorable dielectric power factor, mechanical strength and voltage fatigue.

Using mica in flake form means transforming a bundle of flakes into a compact insulating covering for an armature coil. Only recently was a practical solution found to this half-century-old problem. Now we have mica in the form of mica paper for Class B and Class H armature insulation of rotating machines.

History. Near close of the nineteenth century the ac generator came into the power picture. It followed the general construction pattern of the dc machine in that it had a stationary field and rotating armature with collector rings. As machine capacity and operating voltages increased, mica in several forms replaced varnish fabric materials for armature coil insulation. This came about because of mica's high heat, compression resistance and high voltage strength. Disadvantages of the rotating armature were soon realized. Then followed the stationary armature ac machine. This machine could readily be built for higher voltages; therefore, mica insulation was retained.

Then about beginning of the twentieth century, flake mica tape bonded with clear resins came into being. By 1915 some motor manufacturers had replaced the brittle, high-dielectric-loss, clear-bonding resins with blended-asphalt-base, flexible, low-dielectric-loss material. Excellent performance of this asphalt-bonded, vacuum-compound-pressure treated, flake-mica tape, full Class B armature coil insulation over the continuous period starting with 1915 was due to two factors. First, the various improvements made in factory processes throughout history of this insulation. And, second, proper blending of asphalt-base materials used.

Mica Mat. The conversion of mica into continuous sheets results from proper processing of small mica flakes into mats. That's why voltage strength of mica when properly processed is relatively high. Mica paper or mat is made by feeding a slurry of fine mica flakes into a paper-making machine. After drying, mica-mat sheet in various thicknesses is produced in continuous-length



STATIONARY ARMATURE coil of 13,8-kv machine. In manufacturing mica in this new form, natural mica is broken into flakes then mixed with water. Mat is formed by process similar to paper making

POLE-FACE bar for dc machine. Self-supporting ribbon of pure mica has a dielectric strength of about 400-v per mil. Its tensile strength is 1000 psi with thickness variation of only 10%

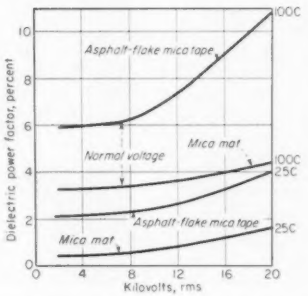
Insulation for Armature Windings

rolls. Mica mat has the same resistance to destructive forces and the same chemical and electrical qualities as flake mica.

At present, pure mica mat is mechanically not strong enough for general-purpose insulation. Thus, suitable reinforcing materials, such as bonding resins, and solid materials, such as paper and various fabrics, are used to obtain the desired electrical and mechanical properties. Here are some of the advantages of mica mat over built-up flake mica: More uniform thickness, more uniform bond content, more uniform filling, less mica voids, greater availability (independent of foreign sources of supply), better flexibility for application, better-controlled manufacturing processes.

Thus after about 50 years of service in the insulation system of rotating machines, flake mica will be replaced by a new form of mica.

Sheet and Tape. Asphalt-base materials, alkyd resins, silicones and various modified polyester resins can be used to bond and fill mica-mat sheet and tapes. Which is used depends on the characteristics wanted. With suitable reinforcing or backing materials, many different types of mica-mat insulating materials can be had for insulating components of rotating machines. Mica-mat tapes have enough flexibility for



POWER FACTOR is measure of insulation quality; low pf means small void content

taping both coils and coil connections.

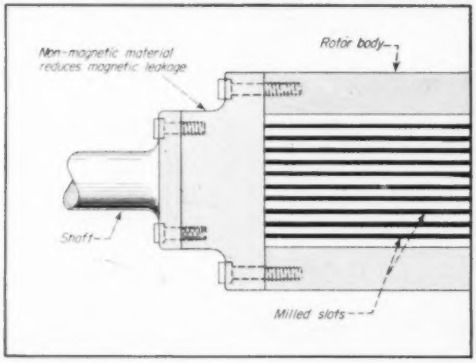
After several years of experimentation a certain type modified polyester bonding resin came into the mica picture. This resin was found quite satisfactory for bonding and filling mica-mat tape insulation of high-voltage armature coils. This new type of bonding resin was developed especially for mica mat, but it can also be used in flake mica-tape insulation. Since it was believed that mica-mat insulation would eventually supersede flake-mica insulation, development activities were directed to mica-mat applications. Modified polyester bonded mica mat insulation is also a new type of armature insulation because it differs structurally from flake mica bonded with various resins.

Advantages. Dielectric power factor is a measure of insulation quality. A low power factor indicates a relatively small amount of ionization within the insulation; hence a low void content. It also means a low dielectric loss in the bonding and insulating materials. Note dielectric power-factor curves to left.

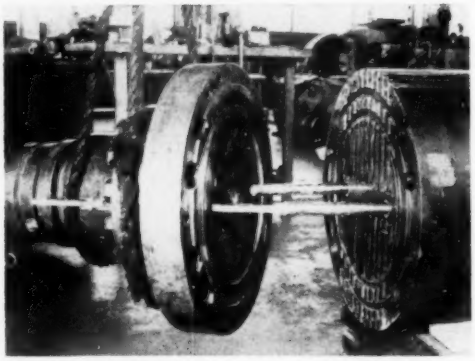
Mica-mat insulation has about 50% more voltage strength than conventional asphalt-bonded flake-mica insulation. It has less tendency to swell at elevated temperatures and its mechanical strength is higher. Mica paper or mat is less affected by increased temperature than conventional asphalt bonded flake mica tape insulation. The latter has been used successfully for many years.

Mica mat insulation is now being made on a pilot-plant basis. But manufacturing facilities will soon be available putting this new form of mica insulation on a production basis. Remember, mica-mat insulation is a new type insulation, not conventional flake mica tape with different bonding material. From tests, there is all indication that this new paper-like mica insulation offers a big improvement in insulation quality of high-voltage armature coils.

PARALLEL-SLOT construction, using shaft-stubs bolted to the rotor...

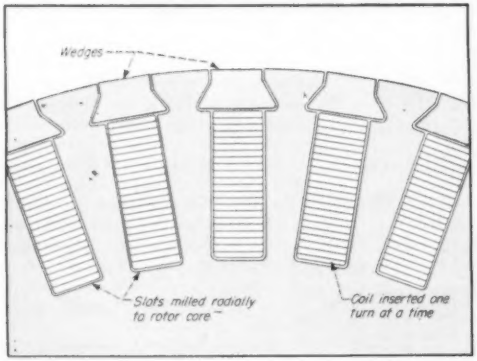


MILLED SLOTS, parallel design, are cut across rotor ends and also along the length of core running parallel to shaft axis

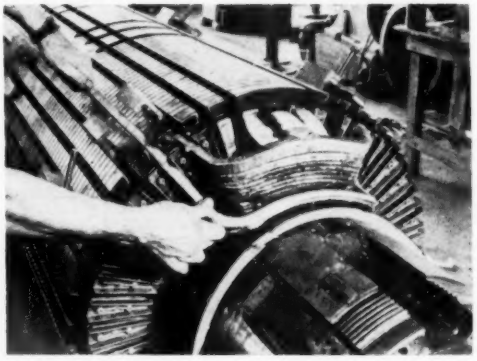


TYPICAL PARALLEL-SLOT rotor of early turbine-generator. In this design the shaft is flanged and then bolted to rotor core

RADIAL-SLOT design in this country favors milling slots directly...



MILLED SLOTS are radial to rotor core. After winding is completed, wedges inserted in the slots hold coils from moving out



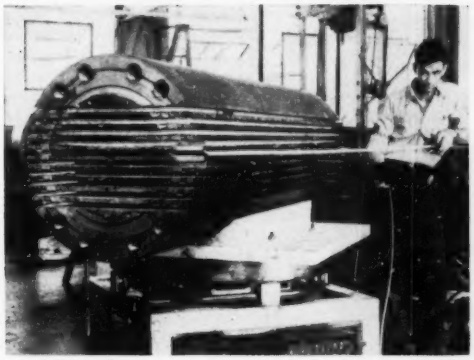
MILLED RADIAL SLOT is accepted design today. Note one coil in place, another building up. Turn at a time fed into slots

Slot Construction Is Rotor Design Key

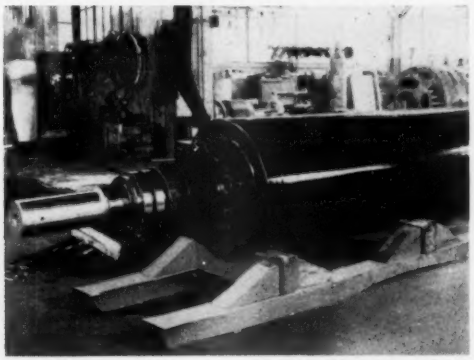
By **CELSO GENTILINI,** *Asst Chief Engineer, National Electric Coil Co*

Today's high-speed generator rotors do a man-sized job. They must stand up mechanically and electrically under high centrifugal stress. Here's why they can do that job . . . efficiently

...core through the end flanges, has bowed out to the radial slot

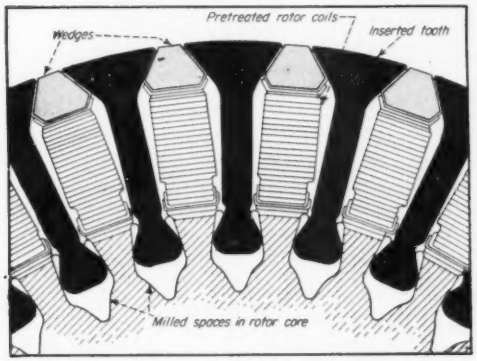


EASE OF WINDING is one advantage of parallel-slot rotor. Wire and turn-insulation fed as core rotates on vertical turntable

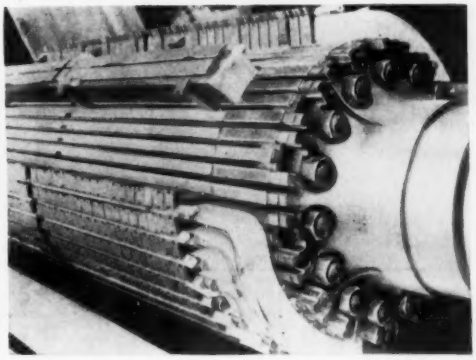


COMPLETED parallel-slot rotor. Leads from field winding are brought out through driving head to collector-rings on shaft

...in the rotor rather than using separate teeth inserted in grooves



ROTOR CORE is slotted to receive many laminated teeth. When in place they form sides of slots holding preformed coils



INSERTED-TOOTH construction uses machined teeth fitted in milled grooves in rotor core. Wedges lock the teeth together

► UNLIKE ITS DC BROTHER the ac generator has its field winding in the rotor rather than the stator. Leads from this dc field winding are brought out to the shaft collector rings. Two general types of rotor construction for 3-phase generators are: *Salient* or projecting poles for slow-speed machines and smooth or *non-salient* poles for high-speed units. Non-salient construction is used in today's high-speed turbine-generator units to cut windage loss and noise. Stresses at high speeds rule out the salient type.

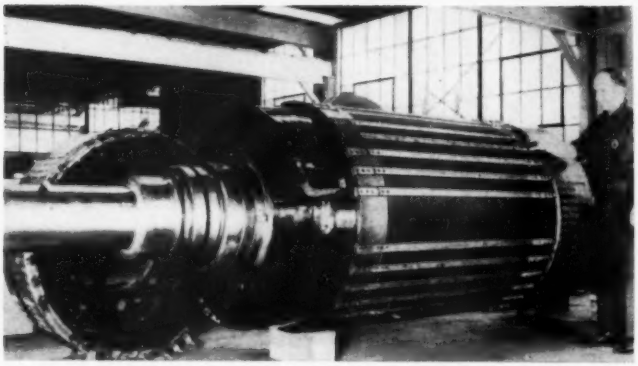
We can further break down rotor construction into: (1) solid core and (2) core of bolted steel plates. In both, slots form runways for the field windings. These slots can be either parallel or radial.

Parallel Slots. Some of the earliest 3-phase turbine-generators used the parallel-slot type of rotor. In these units the shaft did not penetrate rotor core. A driving head or flange was bolted at each end of core to carry shaft stubs.

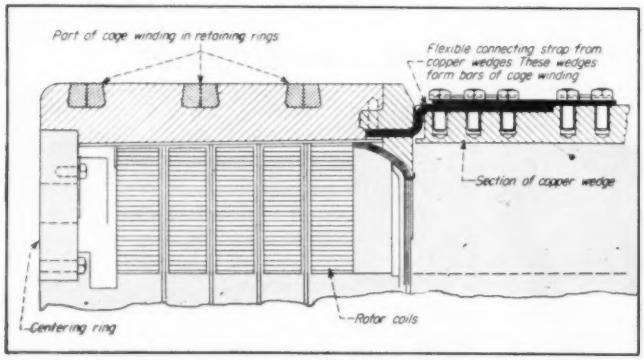
Parallel slots make coil winding a cinch. To wind, rotor is placed on a turntable that rotates as windings are fed into slots. Coils can be wound under tension. And since conductors are usually thin, wide straps, they can be wound tightly forming a substantial, solid winding. Finished winding is held snug with metal wedges atop each slot. With parallel slotting, no additional support or banding is needed against centrifugal stresses. This was one of the factors that helped make the parallel-slot a leader during development of the turbine-generator.

One drawback to parallel-slot design

SINGLE-PHASE rotors need copper cage winding



SHORT-CIRCUITED cage winding is designed to carry the rotor's heavy surface currents. These copper bars do a double job—carry current and hold field coils snug


Part of cage winding in retaining rings
Flexible connecting strap from copper wedges These wedges form bars of cage winding
Section of copper wedge
Centering ring
Rotor coils

COPPER WEDGE, shown to right of flexible shunt, runs parallel with other bars all along rotor face. It connects to the retaining ring on far side of the rotor

is its limited copper space. Slot spaces cover a smaller portion of total circumference compared with radial-slot rotors. Heat dissipation is another limitation. New forging techniques laid foundation for one-piece core and shaft.

Radial Slots. As years slipped by, parallel-slot construction bowed out to the radial-slot design. At present, there are two approaches to radial-slot construction. In one, the laminated rotor core has milled radial slots. In the other, slots are formed by dovetailing teeth into milled grooves in core body. This latter inserted-tooth technique has found wide use in Europe. American manufacturers have generally adopted the milled-slot design.

With the milled-slot rotor, coils cannot be formed and completely insulated before slipping into place. They must be inserted into slots one at a time. Each turn may be pretaped, inserted and turn-insulation applied as winding progresses. But with the inserted-tooth design, coils can be completely formed, insulated and placed in position as a complete unit. Then the dovetailed teeth are slid home.

One advantage of inserted-tooth construction is coils can be completed and tested before installing. Another feature is better coil ventilation. Nevertheless, American manufacturers feel these advantages are outweighed by the main disadvantage—cost of machining and assembling the many pieces.

Milled-slot windings are held in place by metal wedges fitted into the machined grooves atop each slot. Supporting the end windings, however, presents an additional problem. Two methods have been used to hold endwindings snug: (1) steel-alloy retaining ring (2) steel

(*Continued on page* 204)

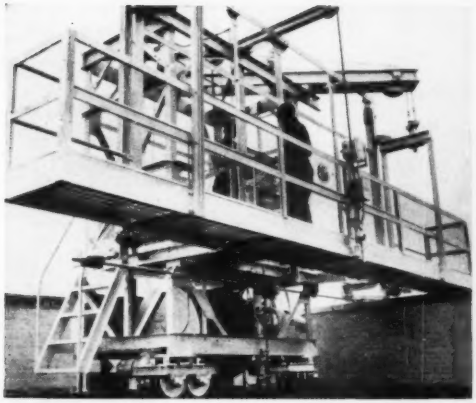
Another Look at Lubricant Purchasing

► FURTHER REFLECTION on the article, "Straighten Out Lube Purchasing" (May, p 100), makes us wonder if it may leave you with an impression that specifications alone should be the basis for buying lubricants. That was certainly not our intention in condensing the paper originally presented by C A Bailey at ASLE annual meeting.

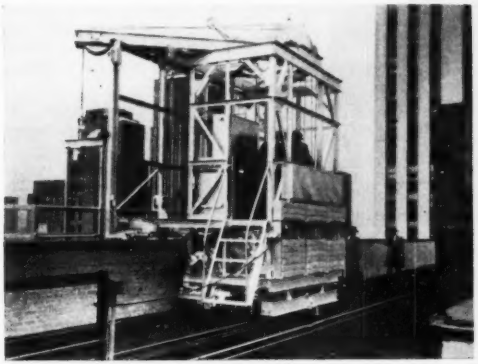
In general, the suitability of a lubricant for any specific purpose can only be determined by performance testing. Engineers in large plants may use their many years of wide experience with lubricants on the job as a basis for judging performance acceptability. In the more usual case, the lubricant supplier performance-tests his products in the laboratory and in the field. Using such performance data, the reputable manufacturer then produces branded lubricants for specific jobs and backs these with his name and reputation.

Look upon a specification as a numerical listing of some of a lubricant's physical properties; viscosity, viscosity index, specific gravity, flash, fire, pour point, etc. When used properly it has virtues for both maker and user. It helps the refiner control uniformity of a product. It helps the user check uniformity of the branded product purchased, and sort out and classify lubricants as pointed out in the May article of POWER.

In the latter respect particularly, specifications can do much to make your job of stocking and using lubricants easier. But without performance experience on a lubricant, specifications can't successfully forecast behavior of that lubricant in a specific job.—ED.



ROOF-CAB juggles scaffold off parking "spur" to "main" line. Cab can't move till the scaffold is secured against its side



OVER THE SIDE and ready to lower; travel controlled from scaffold. Phone links the platform cab and maintenance office

SCAFFOLD is lowered and raised by cables motor-powered from roof-car. Platform travels on guide rails in building face

Outdoor Elevator Speeds Window Washing

By **JOHN ADAMS**, *Engineer, Otis Elevator Co*

► SLEEK NEW 24-story headquarters of Lever Brothers Co in New York City boasts an outdoor window-cleaning machine for its 1404 fixed, non-opening windows. With this combination window-washing and maintenance unit, two men can clean outside of all 1404 windows in six days.

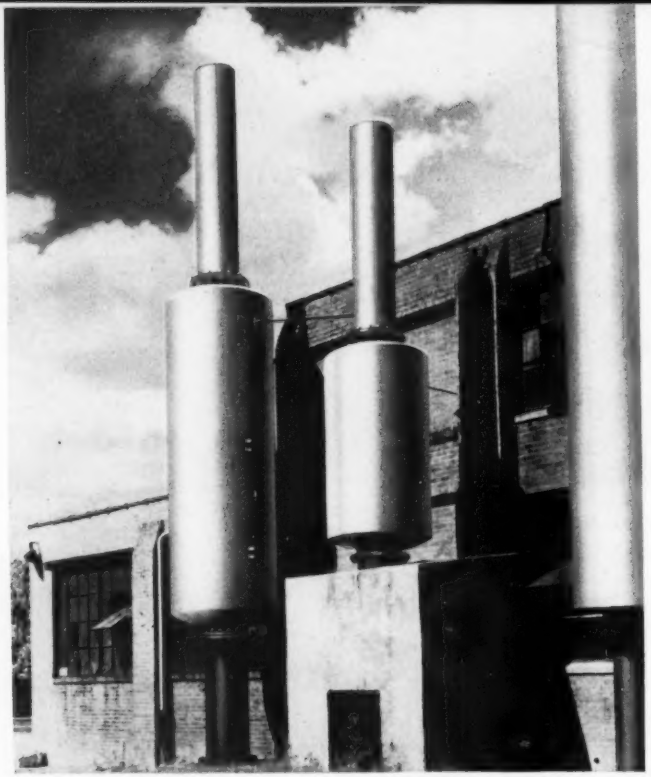
Two-part unit has a roof-car that rides on roof tracks and a 28-ft scaffold that travels up and down building sides. Roof-car is essentially a miniature locomotive run by two 1-hp electric motors. A 7½-hp squirrel-cage motor raises and lowers maintenance scaffold.

Vertical movement of platform is normally controlled from the scaffold. In an emergency, pushbuttons in roof-car can operate scaffold. It can't be moved while roof-car is moving, or when scaffold is not in the precise horizontal position to engage the stainless-steel, T-shaped, vertical guide-rail fixed to the sides of the building.

Scaffold, weighing 3000 lb, is designed to carry 1500-lb load. Ordinarily only two men with window-cleaning equipment ride the scaffold. Platform is supported by four galvanized ¾-in. steel-wire hoisting ropes with a breaking strength of 9000 lb each. Ropes give safety factor of eight.

Operating cycle starts with exact positioning of car at marked point on roof track. Scaffold is swung out and lowered so platform shoe engages vertical-guide T-rail. Window washers then lower platform, floor by floor, cleaning six windows per floor until lower limit, the third floor, is reached. Platform is then raised to roof, swung in against roof-car, moved to next position, and cycle repeated. Power cable feeding the roof-car is changed from outlet to outlet on roof as car moves around top of building.

This outdoor elevator cost about $50,000. Although unit is ordinarily considered a window-cleaning aid, it also serves well for general exterior-building maintenance. Typical would be replacing broken window panes, repairing window seals, general cleaning of stainless-steel trim on sides of building.



EXHAUST AND INTAKE snubbers muffle air and gas noises of engines in municipal power plant. Well-kept units like these mean quiet operation in residential areas

You won't understand diesel and gas-engine mufflers unless you know a little about sound. So this article, first of three, starts you off with a quick report on . . .

NOISE: How to Keep It Out of Your Diesel Plant

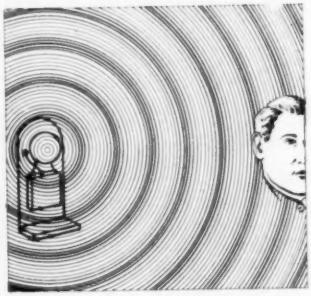
By **TYLER HICKS**, *Associate Editor*

► YOU CAN DEFINE sound in two ways. Crudely, it is anything you hear. In engineering terms, it is waves of alternate condensation and rarefaction through an elastic body — gaseous, liquid or solid. Noise is sound of any kind, especially disagreeable and confused kinds.

Sound Transmission. An elastic body vibrating rapidly enough in air sets up compression waves, Fig. 1. These are called sound waves since they produce the sensation of hearing when they reach our ears.

Condensations and rarefactions are caused by the vibrating body. It alternately pushes against and pulls away from air around it. Each impulse is transmitted to your ear if you're within hearing distance. Air pushes against your ear drum, draws it out again during rarefaction, and you're conscious of a sound. Small pressure variations accompany sound waves.

"See" sound waves by...



1 **CONDENSATIONS** and rarefactions in air are produced by vibrating bell

Wave Forms. To study sound the wave is converted into a form resembling a sine curve, Fig. 2. Waves do not look like these curves, but several properties of the curves are useful in classifying sounds.

Uniform noise vibrations, like those of the clarinet, Fig. 2, can be pleasant to the ear. But non-uniform vibrations from an internal-combustion engine without a muffler, Fig. 2, are often unpleasant.

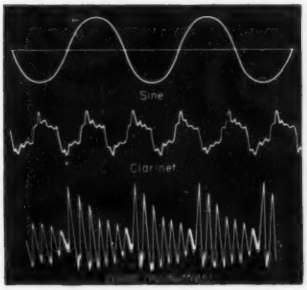
Characteristics. Pitch classifies sound as high or low. High-pitch sounds have high frequency, short waves. Low-pitch waves are long, have low frequency.

Sound intensity is measured in decibels (db). This unit is a ratio of sound measured to a previously found zero level. A sound of 0 db is on the threshold of audibility. Whispers have an intensity of 10 to 20 db, average factory noise is 60 db and upward, an unmuffled airplane engine noise is 110 db, the threshold of painful feeling. Ordinary sound levels run between 0 and 110 db.

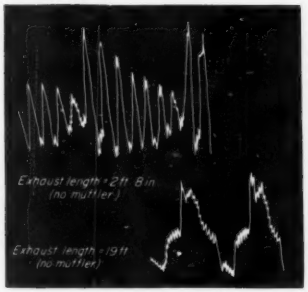
Most sounds and noises have certain dominant notes, fundamentals, as well as other notes, overtones. Quality of sound depends on relative strength of overtones united with the fundamental. Simpler overtones are called harmonics and usually make agreeable combinations with the fundamental and each other. Discordant overtones cause unpleasant sounds.

Engine Noise. Diagrams at right show how engine exhausts make noise. When exhaust valve or port opens, exhaust gases rush into outlet pipe in the form

...plotting these curves for various sounds



2 **SOUND WAVES** are often converted to curves like these for easier study



3 **EXHAUST-PIPE** length changes shape of sound waves as two curves show

of slugs. Expanding slug makes air vibrate, creating noise. Also, slug leaving pipe pulls some gas with it, creating a partial vacuum in exhaust pipe. Slug of air rushes into pipe, causing more noise, large pressure fluctuation.

Low-frequency noise from engines is booming or thumping sound. High-frequency noise is banging or screeching. Intake noise results from air-flow impulses that set up vibrations. Character of noise depends on vibration frequency.

Resonance. We're all familiar with musical instruments whose sound intensity is increased by varying the length of an air column. Exhaust pipes connected to internal-combustion engines can behave in the same manner. Besides increasing exhaust noise, length of the line may cause power loss and excessive gas temperature in 2-cycle engines. Fig. 3 shows effect of exhaust-pipe length on gas-pressure pulsations.

With a favorable pipe-length pressure, oscillations aid in scavenging when engine runs at constant speed. High-speed 2-cycle engines are often sensitive to exhaust-line length and backpressure. Pulsations and high backpressure are especially harmful to crankcase-scavenged 2-cycle engines.

Noise Reduction. Most complaints about municipal and industrial diesel plants are concerned with noise, not with exhaust odor and temperature. Noise can be annoying, especially at night in residential areas. Katydids, crickets and barking neighborhood dogs may make more noise than a municipal diesel plant in a residential area, but the diesel's noise is the one complained of. Noise reduction is not only good public relations—it may also save you from the need of moving a plant, changing exhaust hookup or explaining in court why the plant is so noisy.

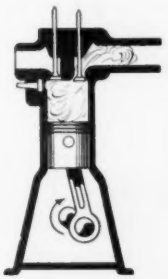
Of course exhaust-gas temperature and odor are of some importance when planning plant layout. Exhaust gas must not impinge on flammable materials nor should it enter spaces occupied by human beings or animals. Easiest way to make allowance for these factors is to run exhaust pipe above surrounding structures, photo, p 86.

Effective noise reduction requires careful study by engine designer, plant operator and muffler manufacturer. Engine designer specifies the amount of backpressure his engine can stand without excessive loss of power output. Plant operator must tell muffler manufacturer maximum noise level tolerable in his area. And manufacturer must design and build a muffler that is suited to engine, has a cost that isn't too high, and a strong structure easy to clean and maintain.

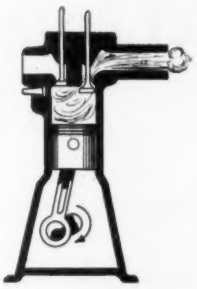
The days of rock-filled concrete-pit-type silencers are gone. Today we have specially designed units for a variety of applications with different engines. Besides reducing exhaust noise without excessive backpressure some silencers serve as waste-heat boiler to generate steam or hot water. Others give 100% trapping of sparks and carbon in exhaust gas.

Many silencer types are available in models suitable for vertical or horizontal mounting. Some designs must be mounted within a certain distance of the engine while others may be put in any convenient spot inside or outside plant building. Tailpipes are needed on almost all silencers but length depends on design, service and other factors. Where only prevention of sparks and carbon is desired, units for this use are available. Next month we'll see how the principles of sound are applied in building silencers for modern diesel and gas-engine plants.

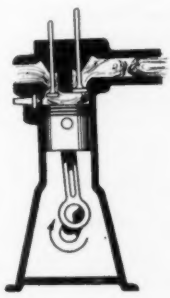
HOW DIESEL AND GAS ENGINES MAKE NOISE



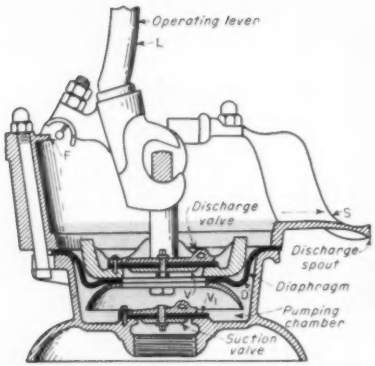
VALVE OPENS. Gas in engine cylinder is above atmospheric pressure and temperature at end of power stroke. When the exhaust valve or port opens, gas rushes into the pipe in high-velocity slugs



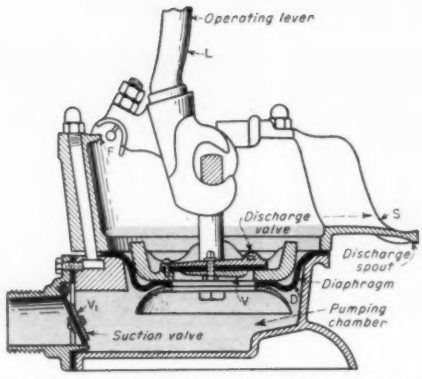
SLUG HITS AIR. Leaving slug smacks air, causing noise. Gas sucked along by slug leaves partial vacuum in pipe. Also, some cooling of gas and condensation in the pipe helps create a vacuum



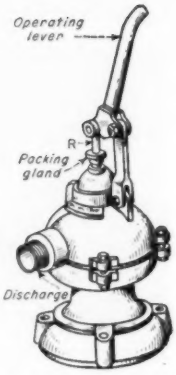
AIR RUSHES IN. After gas leaves pipe, air rushes in, causing more noise and pressure fluctuation. Pressure waves of large magnitude reflect in pipe at acoustic velocity. The exhaust noise gets worse



1 Hand-operated suction-type pump has a discharge valve in the diaphragm



2 Same pump as Fig. 1, but the suction valve swings sidewise, not vertical



3 Pressure-type diaphragm pump has packed stuffing box on piston rod

Get Acquainted With Diaphragm Pumps The Old Reliable Work Horses

By F A ANNETT, *Contributing Editor*

Unless you know these designs and the wide range of applications they're suited for, you may be missing a good bet. Here's how several types operate, how they're applied

► DIAPHRAGM PUMPS have become numerous and healthy members of the pump family. They handle materials that cannot be satisfactorily and economically handled by other types of pumping equipment, such as abrasives, thick materials, or fluids that tend to clog or build up on pumps. Special designs pump acid, alkaline and other corrosive solutions. They are inherently small- to medium-capacity types, and in conventional designs are limited to heads up to about 50 ft.

Conventional designs are short-stroke positive-displacement pumps that have the equivalent of a relatively large-diameter piston, operating at about 50 to 100 strokes per minute when power driven. Best known is the old hand-operated type, Fig. 1, invented nearly 100 years ago by Jacob Edson of Boston, Mass. A rubber or synthetic-rubber-and-fabric diaphragm *D* bolted in place closes pump top and is connected to an operating lever *L*, fulcrumed at *F*.

In the diaphragm center is a discharge flap valve *V* with a suction flap valve V_1 above the intake. These valves, made of material like the diaphragm and held between two metal plates, are fixed at one side so they swing upward. When the pump is primed, lifting the operating lever flexes the diaphragm downward to force liquid up through the discharge valve above the diaphragm.

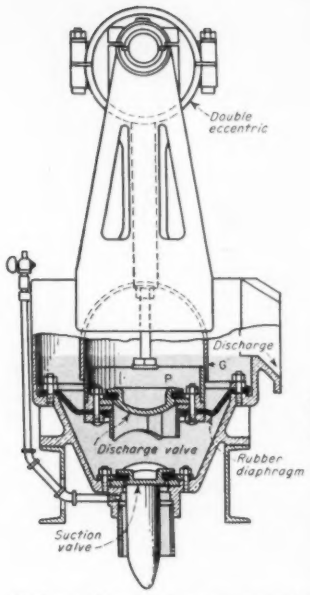
Pulling lever *L* down raises the diaphragm, causing the discharge valve to close and fluid to flow out discharge spout *S*. Lifting the diaphragm reduces the pressure in the pumping chamber to where liquid flows in through suction valve V_1 to fill the chamber, ready for diaphragm's next downward stroke.

Side Suction. Fig. 2 is a side-suction design of the pump in Fig. 1, in which suction valve V_1 swings horizontally instead of vertically. This design permits the suction line to be connected to side of pumping chamber, which is often a more convenient arrangement than a connection at the bottom.

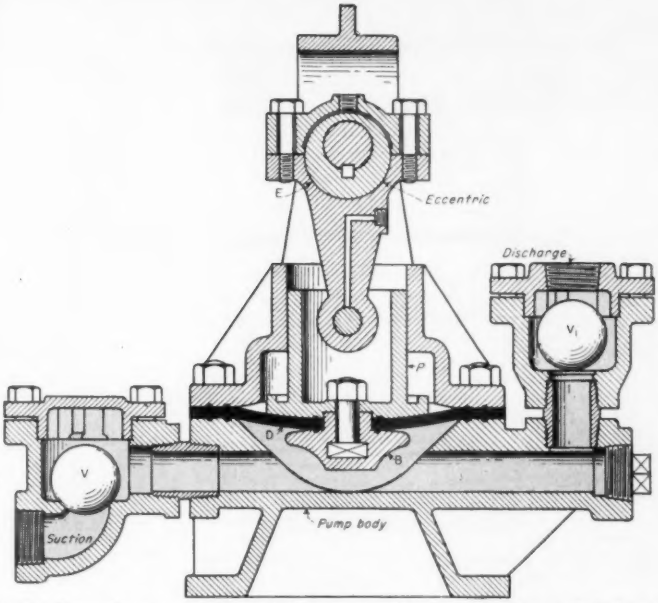
Pressure pumps, Fig. 1 and 2, can be used only to lift liquid and so are limited to not over 25 ft (better 20 ft) in a single lift. Maximum capacity is obtained at about 10-ft suction lift under normal conditions. For higher suction lifts, capacity decreases until at 20 to 25 ft lift it is only about one half that at 10 ft. To have these pumps discharge against pressure they are made with a closed top, Fig. 3, with the operating rod *R* going through packing in top of enclosure.

These pumps, besides lifting liquid the usual 20 to 25 ft, can force it against a discharge head of 20 to 25 ft, or a total head of 40 to 50 ft. Thus, when dewatering deep excavations, pump may be placed within proper suction distance of the water level and the discharge piped to take care of the remaining distance that water must be lifted. With this type pump, discharge head should not exceed 25 ft or diaphragm life is reduced.

Power-Driven Units. Hand-operated pumps have lost much of their popularity so the designs in Fig. 1 and 2 have been developed in many power-driven forms. These pumps have been called the old, dependable, foolproof work



4 Power-driven diaphragm pump run by adjustable eccentric on drive shaft



5 Power-driven pressure-type diaphragm pump has its ball suction and discharge valves inside the pumping chamber to eliminate the packing on the piston rod

horses that stay on the job under all abuse. They are built in a wide range of portable designs in what is known as contractor's pumps for unwatering excavations and keeping them that way. Here they have to handle water heavy laden with sand and silt, ruinous to other pumps that have rubbing parts or close clearances.

Fig. 4 shows a cross section through one design of power-driven diaphragm pumps for stationary service. Plunger *P* does not move in a cylinder but runs in circular guide *G* and is attached to the center edge of a diaphragm. Outer edge of the diaphragm bolts to a flange on the pump casing. A discharge valve in the plunger's center and a suction valve in the bottom of the pump's casing are flat types with renewable rubber and fabric rings that close on rubber seats.

An adjustable eccentric on a straight shaft drives the plunger so any stroke from about ½ in. to maximum can be obtained. These pumps operate at comparatively slow speed of about 60 strokes per minute. They are made in simplex, duplex, triplex and quadruplex designs and may be driven by a direct-connected gearmotor, or by a motor through a belt, chain or gears. Most portable pumps of this type are driven through gears by small gasoline engines.

No Packing. Using packing on the operating rod of the pressure pump, Fig. 3, defeats one of the claims in favor of diaphragm pumps—"no packing to maintain." Packing can be eliminated on pressure pumps by putting the discharge valve in the pump body, as in Fig. 5. It has a rubber or synthetic-rubber diaphragm *D* connected to a piston *P* by a backing plate *B*. Lower end of piston and backing plate are formed to flex the diaphragm with a minimum of wear and fatigue. Piston *P* serves as a guide to keep the piston-rod thrust always at right angles to the diaphragm and wear on the latter at a minimum.

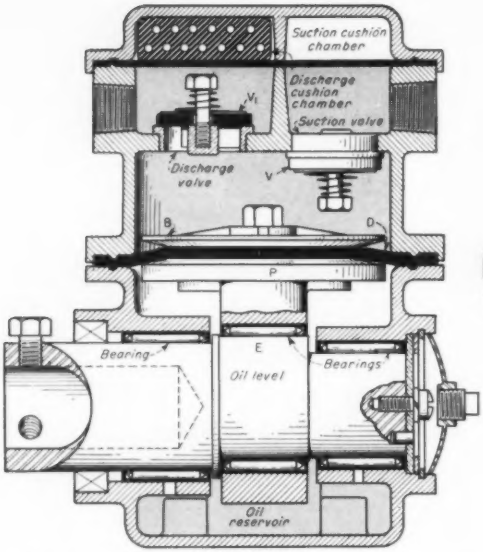
Ball suction and discharge valves *V* and V_1 are in pots threaded to the pump body. Pump is driven by eccentric *E* keyed to the driveshaft. On the upstroke, eccentric extends the diaphragm upward to produce a vacuum in the pumping chamber, causing liquid to flow in through the suction valve. On the downstroke, diaphragm is flexed downward, which closes the suction valve and forces the liquid out the discharge to any elevation within the pump's rating. Discharge pressures are limited to 50 psi, capacities to 15-75 gpm and liquid temperature to 160 F.

Spray Pumps. Fig. 6 is the cross section of a diaphragm pump especially adapted for spraying corrosive and abrasive chemical solutions. It is essentially a reciprocating pump with a large bore and a short stroke, about 3/16 in., with a working diaphragm acting as a flexible partition between pumping and bearing chambers. Because of its short stroke, the pump can operate at much higher speeds than most diaphragm types. Capacity is about 1 gpm per 100 rpm, up to 600 rpm and 80 psi. Normal working pressure is 50 to 60 psi.

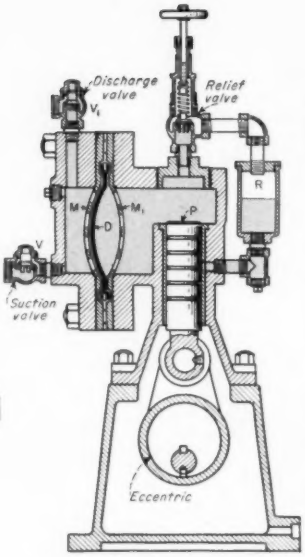
To operate at high pressures, diaphragm *D* is supported by top of piston *P* on the pressure stroke, and the backing plate *B* on the suction stroke. This takes the load off the diaphragm over its entire area except for about 1/16 in. around the circumference of the piston head.

Piston that operates the diaphragm is actuated by a simple eccentric *E* on a heavy ground shaft running in 4½-in. needle bearings. Eccentric shaft and bearings run in an oil bath, kept clean by complete sealing in the bearing housing.

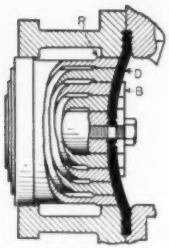
Valve Design. Discharge valves V_1 and suction valves *V* are of conventional design, made of neoprene on bronze seats with stainless-steel or phosphor-bronze springs. Suction and discharge



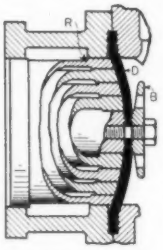
6 Short-stroke high-speed diaphragm spray pump operates at 60 to 80 psi and 600 rpm, and handles chemicals



7 High-pressure pump operates on two fluids: pumped and pumping



8 Piston diaphragm, suction position



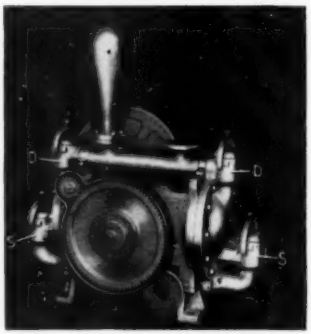
9 Piston diaphragm, discharge position

cushion chambers are large in proportion to the pump's displacement. These above the valves act as air chambers to smooth out pulsations due to the reciprocating actions, and increase pump life.

Pump, Fig. 6, is also made in a compact double-diaphragm design to increase the capacity. At 200 rpm and 80 psi it has a capacity of 5 gpm, and at 430 rpm of 10 gpm. At speeds less than 200 rpm the pump may be operated at pressures up to 125 psi.

High Pressure. To operate diaphragm pumps at high pressures, pressure must be practically equal on both sides of the diaphragm at all times as in the pump, Fig. 7, good for 300 psi at $\frac{1}{8}$ to $\frac{1}{2}$ gpm. To protect diaphragm *D* against excessive deflection it is supported between two perforated metal disks, *M* and M_1. In the pump are two fluids, the pumped on left and the pumping (oil or other hydraulic fluid) on right of diaphragm.

Piston *P* is at upper end of discharge stroke and diaphragm *D* is deflected to the left in Fig. 7. Downward movement of the piston forms a vacuum in the pumping chamber and the diaphragm moves to the right to reduce pressure in pumped chamber. Fluid then flows in through suction valve *V* to be forced out discharge valve V_1 when the piston on its upward stroke displaces liquid in the pumping chamber to force diaphragm to left. If pressure in the discharge line becomes too high, that in the pumping chamber increases to where the relief valve opens and bypasses pumping liquid to reservoir *R*. From here it flows into the pumping chamber on the next downstroke, so this chamber is always full when the piston starts on its discharge stroke.



10 Piston-diaphragm pump in which the piston consists of 4 concentric rings

Piston and Diaphragm. Fig. 3 and 9 show cross sections through one piston of a double-acting combination piston and diaphragm pump. It is designed primarily for handling abrasive and corrosive slurries at pressures from 50 to 100 psi, and feeding them to pressure-type filters. It is also used for many other purposes, including handling latex creams where the gentle pumping action, 65 to 70 pulsations per minute, helps to prevent coagulation of the material being pumped.

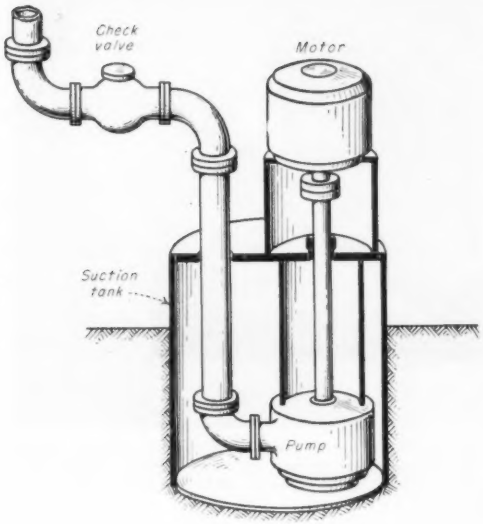
Piston comprises a series of concentric rings, *R*, as in the figures, each actuated by a separate cam. A heavy rubber or synthetic-rubber diaphragm *D*, suited to the fluid handled, separates each liquid end of pump from the pistons and working parts. At end of suction stroke the draw-back disk *B*, in combination with the piston rings, shapes the diaphragm to form a concaved surface of a sphere, Fig. 8. At end of discharge stroke the piston rings shape the diaphragm to a convex surface of the same sphere, as in Fig. 9. Thus the diaphragm is supported by the piston at every part of both pressure and suction strokes.

Liquid End. Ball suction valves *S* and discharge valves *D* are placed in each head or liquid end of pump, Fig. 10. Liquid ends include the valves and can be easily removed as a unit for inspection and cleaning. Only the liquid ends, the discharge manifolds and air cushion chamber come in contact with the fluid handled.

First article in a series of two. The next story will deal with variable-delivery and special diaphragm pumps.

Rx Could You Cure This Headache?

By DONALD C SWIFT, *Ebasco Services Incorporated*



Case No. 10—

The Temperamental Condensate Pump

► AFTER A SERIES of last-minute snarls we finally got the second condensate pump of a new unit into operation. Immediately the pump with its motor drive vibrated so much we were afraid to run it, except in extreme emergencies. Pump design was somewhat unusual, see sketch. The motor rested on a high pedestal set on top of suction tank. The tank projected several feet above the floor level. A flat plate, 2 in. thick, formed the tank top.

The pump casing hung from the plate. The 2-stage overhung pump impeller had a single-sleeve-type bearing. Motor drove the impeller through a special solid-type coupling. The upper thrust-type ball bearing of the motor carried the combined weight of pump impeller and motor rotor.

Pump and coupling were furnished by one manufacturer, the motor by another. Each thought the other's equipment was at fault. After several independent tries, the service men of the two manufacturers worked together, but still no improvement. A new thrust bearing was installed—no progress.

A machine shop checked the coupling, found everything OK. Coupling and motor were aligned and checked with utmost accuracy. By itself the motor ran with less than 1 mil vibration. Hooked up, motor vibration ran from 15 to 30 mils on various parts of motor.

Pump men said the impeller had been balanced at the factory. Examination through pump suction and inspection plate showed the impeller clean and undamaged. It was a big job to dismantle the pump—so we decided to delay that and do it as a last resort.

More Trouble. In addition to vibration we got very heavy water hammering at the discharge check valve each time the pump started. Dowel pins of the upper pump bearing had been removed to check whether vibration would stop if the bearing block was shifted slightly. With these out, we found this bearing and the motor quickly shifted out of alignment from the heavy water hammering at each start. So we replaced the dowel pins and also doweled the motor in place. This didn't stop vibration, but it kept unit in alignment.

While scratching our heads, wondering what to try next, someone suggested a steady brace from motor top to the nearby condenser waterbox. A 2x4 piece of lumber, set in place loosely, stopped the vibration. Removing it—the vibration picked up to normal in a second or two.

Braces to building steel, running at right angles to the first one, had no effect. We concluded the pump had a small amount of vibration. The piping and motor-pump assembly all hanging on the suction-well top was a weight with a resonant frequency building up to high vibration amplitude. We effected a cure through stiffening the motor support by carrying heavy turnbuckles from four points on the motor to outside of pump housing. This raised the frequency of resonant vibration and the motor quieted down to 1 to 2 mils amplitude—a fairly smooth level. An alternate remedy would be steady bars from the pump casing to suction-tank sides. The other three pumps in the plant gave no serious vibration trouble. Evidently their weight balance was somewhat different from our "temperamental" pump.

More Work. This headache out of the way still left the heavy slam in the check valve on pump starts. We tried various amounts of opening on the discharge-gate valve, immediately following the check valve, during starting. No matter what opening we tried, we got a slam that rattled piping all the way to the deaerator. The heavy shock knocked out discharge-pressure gages. We really worried about the valves and piping failing. We tried taking out the check valve disk entirely, but then got a heavy hammer at the gate discharge valve.

The hammer only occurred on starting. When a pump was shut down with the other one running, we got a light rap as the check-valve disk seated, but nothing like the wallop we got from starting.

We finally looked at water levels and found that normal condenser hotwell level was several inches below top of condensate pump's suction tank. Pump discharge line turned upward on leaving the pump casing and came up vertically to a level about 2 ft above suction-tank top. The line there turned horizontally into the check valve. Then it again turned up into the gate valve and connected to the discharge header. This put the check valve 2 to 3 ft above the water in the suction tank. Since the water was under vacuum corresponding to the condensate temperature, the extra downward siphon of water caused water behind the check valve to flash, creating a vapor-filled pocket 5 or 6 ft long. When the pump started raising the pressure a little, this pocket collapsed suddenly causing the heavy water hammer.

New anti-slam semi-balanced check valves were installed right after pump discharge turned upward in tank, replacing original check valves. New checks are below normal hotwell level and discharge pipe stays full of water. We did this on all pumps, took "slam-bang" temperament out of them.

ARM-LIFT Place hands just below shoulder blades and rock forward. Keep elbows straight letting weight of upper body do work. Then rock backward letting your hands run along victim's back and arms till you pick up his arms at point just above elbows. Continue rocking back taking arms up and toward you. Make 10 to 12 cycles per min

New Push-Pull Resuscitation Method

THE 6 GENERAL RULES

1 **Start at Once.** Don't move victim unless location is dangerous. Don't waste time seeking help, loosening clothes, warming, applying stimulants.

2 **Check Mouth.** Remove tobacco, false teeth. Pull tongue forward.

3 **Loosen Clothing.** After victim breathes by himself, or help comes, loosen clothing, keep him warm. Don't interrupt the rhythm.

4 **Stay Put.** Even after he revives, be ready to resume respiration if need be.

5 **Call Physician.** Have someone else get medical aid.

6 **Don't Give Up.** Continue without interruption until victim breathes without help or has been pronounced dead.

► MANY OF US OLD DOGS will have to learn new tricks . . . at least about artificial respiration. The old standby, the Schafer method, is bowing out to the Neilsen, or push-pull practice. This method (new in this country but used many years in Norway and Denmark) does a better job in venting the deep lung areas. By actual measurement the new method pumps about a quart of air during each cycle. In the Schafer method about a pint is exchanged. How do the two differ? Well, the Schafer depends on elastic bounce or recoil of chest and internal organs for pulling in air. The Neilsen has both push-and-pull step. Air intake is not left solely to recoil action of breathing mechanisms.

Further, if there's paralysis of muscles ordinarily connected with breathing, Schafer prone-pressure method produces almost no respiration. Pressure on chest simply collapses it. Sure, it forces air out as it is designed to. But from there, process stops. At release of pressure there's little if any rebound of the respiratory mechanism. Result is no inhalation.

All this boils down to the interesting, troubling conclusion that Schafer method is fine for normal person in no need of help (for instance one acting as a model). But the greater the need of the lad in trouble—paralysis of respiratory mechanism—the less effective is the Schafer. In short, assistance must be given during intake as well as exhaust for best results.

The Approach. Time is of prime importance when a person is not breathing. Don't waste time looking for help, moving him to a convenient spot, giving stimulants, loosening clothing, etc. Only important thing is to start resuscitation at once.

Start by putting the person face down. Turn head to one side and let cheek rest on hands. As in the Schafer, open mouth and check for any obstruction to breathing; for instance, tobacco, false teeth.

Then start resuscitation cycle. And keep it up without interruption till patient is breathing spontaneously or is certainly dead. If he starts breathing on his own he may still need help. If so, adjust your rate to his breathing rate. Don't force your breathing rhythm on him; you may undo your good work.

HIP-LIFT Straddle victim by putting one knee on ground alongside hip. Place hands on victim's back below shoulder blades with thumbs about 2 in. apart along spine. Lean forward with elbows straight. Then release pressure quickly. Place hands under hipbones, not under waist. Lift hips about 5 in. Replace gently; 10-12 cycles per min

Fast Replacing Old Schafer Standby

If other people are standing around, or victim starts breathing on his own, loosen clothing, apply warmth. But don't interrupt artificial resuscitation for these frills.

The arm-lift back-pressure method is shown on p 92. Note in the Schafer it was necessary to raise victim's arms to have chest at maximum chest expansion. But with the Neilsen this is not necessary. Actually, the only reason for having hand or hands under face is to keep dirt out of the mouth.

Take your position at victim's head. Place your hands on his back just below shoulder blades. Rock forward exerting steady, gentle pressure on the back. This forces air out of the lungs. Keep your elbows straight. Let weight of upper part of your body do the work. Release pressure quickly but without giving any extra push at the release.

Rock backward, running hands along victim's back and arms. Pick up arms at point just above elbows. Continue rocking back, taking arms upward, toward you. Use just enough effort to feel resistance and tension in his arms. Chest expands, letting air enter.

Rock forward again, placing patient's arms on ground. Continue motion by sliding your hands down his arms and back till they come to rest again at proper pressure point.

Repeat cycle 10 to 12 times each minute. Establish rocking motion to help keep a steady rhythm. You can change from one knee to other but don't change or break rhythm.

Hip-Lift Method. Right now, all concerned feel the arm-lift method just described is usually your best bet. But what if victim's arm is broken? Think of hip-lift method shown above. Once again, general rules hold. But mechanics are different.

Put one knee on the ground alongside victim's hip. Straddle him, place other foot on ground near the other hip. Put your hands on his back just below shoulder blades. Have thumbs about two inches apart along the spine. Lean forward, keeping your elbows straight. Let weight of upper part of your body put gentle, steady pressure on his back. Release pressure quickly without any extra push at the release.

Place your hands under his hipbones where they touch the ground. *Don't put them under his waist.* Lift hips straight up about 4-6 in. Gently lower hips to ground. *Don't drop them.*

Repeat cycle 10 to 12 times per minute. If a towel is handy, flip it under hips to get better grip. Then simply grasp both ends. But don't waste time looking for a towel. And if you do use this grip-helper make sure it's under hips, not under waist.

Remember this hip-lift method is fatiguing to the operator. Use it only if you can't use back-pressure arm-lift method.

Whether you use the arm-lift or hip-lift, remember, you must continue working many hours if necessary. This method has revived people even 10 hr after natural breathing had stopped. That's why you may work on one knee. Then after half-hour or so shift to other knee and keep on. Even though victim starts to breathe, keep method going some time. Otherwise respiration may fail again.

To speed up teaching of new method, American Red Cross is distributing a supplement to its first-aid textbook.

Basic information and photos supplied by National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.

BIRD'S-EYE view of new Walsall Power Station shows five towers complete while a sixth just begins to take shape. By cooling condensing water in towers, small water sources like sewage effluent, canals and streams provide adequate makeup

The Why and How of England's Big New

By **A E FARMER**, *Generation Engineer, British Electric Authority*

► MANY ENGLISH POWER STATIONS are remote from large rivers or the sea. To make canals and small streams adequate, recirculation of cooling water through towers has become necessary.

By present recirculation methods, the makeup to balance evaporation and bleedoff amounts to about 1%. A 200,000-kw station needs only about 90,000 gph for cooling-water makeup. In a number of cases, sewage effluent is used entirely. In others, it is diluted with river water.

Cooling-Tower Design. The essentials of a cooling tower include:

1. A cooling stack (a) over which the warm water is distributed to present the maximum surface area to the air, and (b) of such depth that the water flowing through has enough time for the desired cooling.

2. A chimney to surround the cooling stack (a) with openings at the base (b) high enough to give the required draft, and (c) with enough area to give the desired rate of air flow.

3. A pond to collect the cooled water.

4. Water suction and delivery pipework or channels, and the necessary distribution penstocks.

Development of the design of the "chimney" or shell, and its manner of construction, has virtually controlled the layout of the other items. Almost universal practice makes the cooling-tower shell of reinforced concrete and of a shape truly hyperbolic or closely approaching it. Sometimes a short, inverted cone is superimposed on a longer one. There is always a smaller diameter, or throat, in the upper half of the tower, and the diameter of the top is smaller than the base.

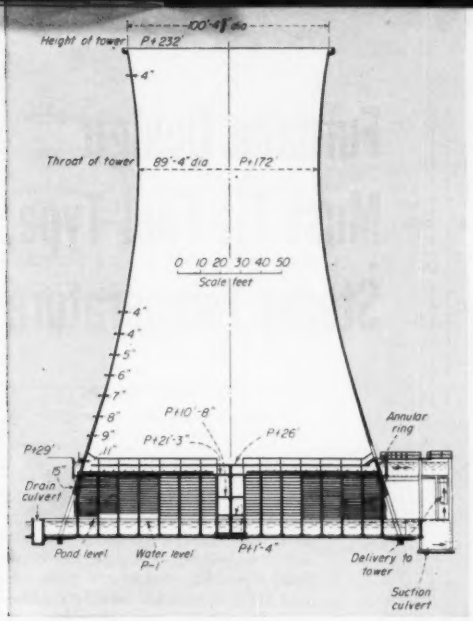
Strength of the reinforced concrete shell is considerable. Thickness of the ring at the base is about 15 in. This reduces to a constant 4 in. at about one-third the height. Drawing above shows a typical design.

The tower shell is supported on 36 reinforced concrete legs sprouting out of a foundation ring beam. The 15-in.-diameter legs are about 20 ft long, including knuckles at the top and bottom junctions with each of neighboring legs.

Until the early 1940s the entire cooling stack inside the tower was made of wood. When wood got scarce, reinforced-concrete, vibrated, precast units were used for the main members, while timber slats were used only for horizontal interlacing members over which the water falls. Spacing between slats controls flow of air through the cooling stack.

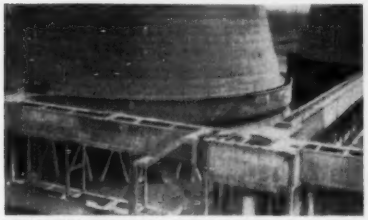
Water distributes to the irrigation system either through an annular culvert outside the tower shell, or through a central surge chamber inside. Irrigation pipes, of asbestos cement for lightness, reduce in size toward their ends. Spray nozzles are rosettes of the same material.

Experiments are under way to find another type of water-spreading system to eliminate the small particles of water that get caught in the air stream. When carried out of the tower these drop on the neighborhood. It's likely the water will be distributed in a thin film over the cooling slats in future construction.



SECTION through typical tower; wall thickness of 15 in. thins to 4 in. one third of the way up, yet strength is very high

ASBESTOS cement pipes are smaller toward end. These spray nozzles are operating at half load



CONDENSER-FED upper culvert feeds annular culvert about each tower in parallel operation

TOWERS are cut out of line for cleaning and repair by closing culvert-regulating penstocks

Cooling Towers

Operation. In general, the towers operate in parallel. Discharge pipe from the condensers delivers water to an upper culvert, which opens into the annular culverts around each tower. Amount of water diverted to any one tower can be controlled by penstocks. In addition, a simple sluice valve controls intake to each distributor pipe within the cooling stack.

After coming through the tower, the cooled water collects in a pond underneath. The pond walls are about 10 ft high. A wall usually divides the pond in halves so one half can be shut off and cleaned while the other half works. All the ponds connect through penstocks to the suction culvert, and both suction and discharge culverts can be sectionalized. Any tower can be completely isolated from its neighbor.

A drain culvert usually runs along the rear of each pond for bleeding water to reduce concentration from evaporation. Penstocks control the drains.

Remedy for Ice. Ice formation is a major problem. Its weight can damage the timber louvers. One remedy sprays warm water from the annular culvert over the outside of the louver ring. Another lowers the pond water level and allows free passage of air beneath the cooling stack.

The size of cooling towers is limited only by the physical problems of construction. There's no special reason for the particular shape they have assumed. The future may see a change in this respect.

Chemical Treatment. The nature of water used for cooling varies so much that the type of chemical treatment is individual with each plant. In all cases, however, both circulation of water around the towers and raising its temperature in the condensers promote rapid growth of algae. If nothing is done to kill them, festoons of algae grow on the cooling-tower louvers. This ends up in condenser tubes fouled with slime, loss of vacuum, and the need for frequent condenser cleaning. Intermittent doses of chlorine proved an effective cure for this time-consuming trouble.

In one case, using canal water, a fine clay suspension caused frequent fouling of the condensers. It was impossible to remove by settling, and only a small part was caught by wood-wool filters. Chlorination, however, prevented its precipitation in the condenser tubes. It was later found that chlorinated algae carried the clay through in suspension.

In another case, using neat sewage effluent, chlorination cured the condenser fouling troubles as long as the circulating-water inlet temperature was 65 F or less. Above that temperature, condenser cleaning was necessary every two weeks, in spite of chlorination. Investigation found that a scale formed in the tubes caused by the deposition of phosphates. These were present in solution and suspension, possibly because of certain manufacturing in the neighborhood. Eliminating these phosphates can be done by coagulation, using chlorinated copperas. But it is hoped that construction of new works at the disposal plant will improve sewage effluent quality of plant waste.

Furnace Design Must Fit Fuel Type, Steam Temperature

By MAX H KUHNER
Vice-President of Engineering
Riley Stoker Corp

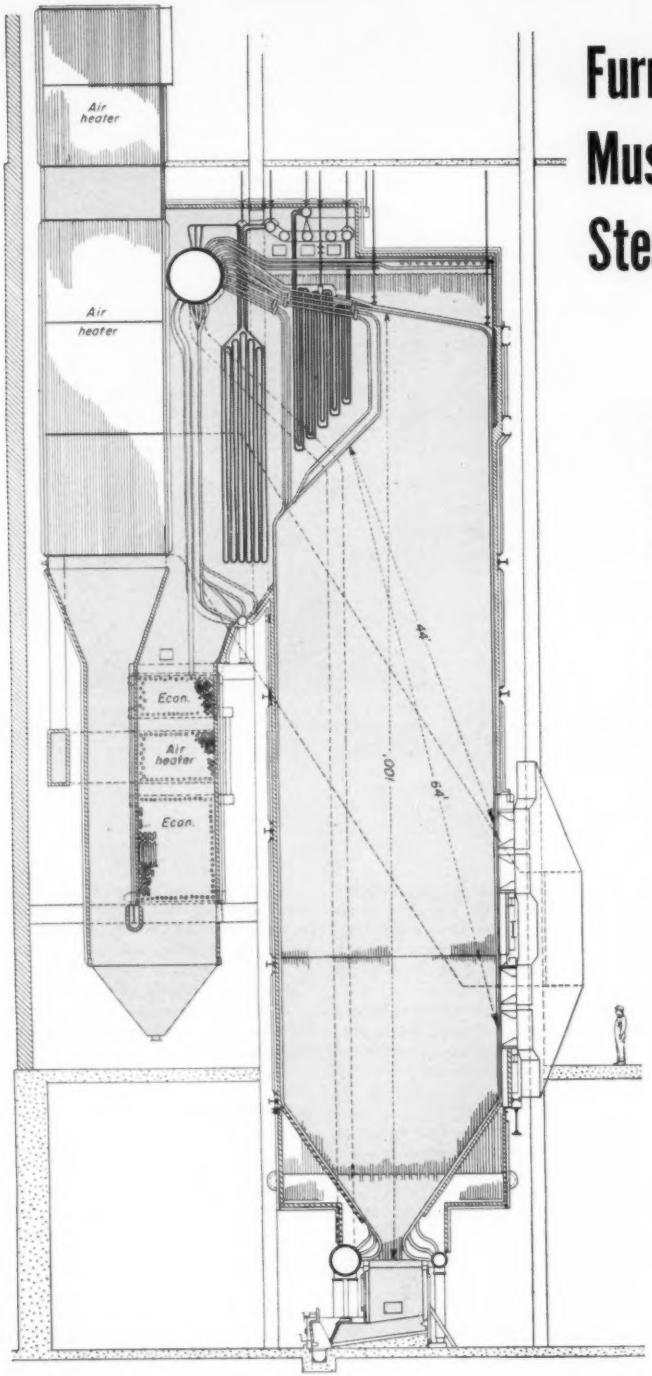
► WHEN CONSIDERING design of new steam-generating equipment, we should assume that the quality of available fuels will continue to decline. Better grades of coal are needed for the metallurgical industry and plants where design of furnaces and fuel-burning equipment forces using premium coals.

Slagging and fouling of boiler heating surfaces can become as serious with oil as with low-grade coal. Improved refinery processes have meant a greater impurity percentage in residual fuel oils. Natural gas is an ideal fuel, but at present a dependable supply exists only around oil and gas fields.

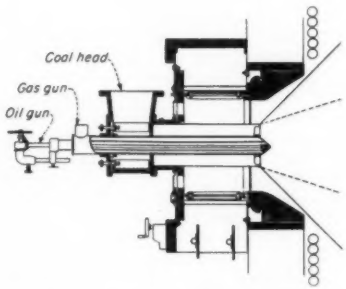
Fuel Flexibility. For economy, it may become desirable to change from one type or grade of fuel to another. Government fuel allocations in national emergencies may force a change from fuel that a plant considers most suitable to a poorer quality or a different type.

Boiler purchasers and designers must keep these considerations in mind. The purchaser must weigh increased investment cost of a unit built for fuel flexibility against possible first cost saving on a design burning only one fuel type, such as high ash-fusion coals.

Saving in first cost may disappear rapidly if the price of one type or grade of



1 **DESIGN** heat-release rate reduced below 75,000 Btu per hr per sq ft of furnace envelope to use poorest grade strip coal, over 15% ash with 1900-2000 F fusion



2 **BURNER** for boiler, *left*, has flame development adjuster for best firing

Furnace design hinges first on types and grades of fuel to be burned. Placement of superheater and reheater in turn depend on the furnace design. First section of two-part article on steam-generator designing

fuel goes up and no use can be made of a lower-cost fuel. Investment savings are spent many times over if a lower-quality fuel becomes the only one available for a furnace not built for its use. This may force a drop in boiler capacity or may require expensive manual labor to fight slag.

Design Factors. Types and grades of fuel to be burned control furnace design. This design, in turn, governs placement of heat-recovery elements.

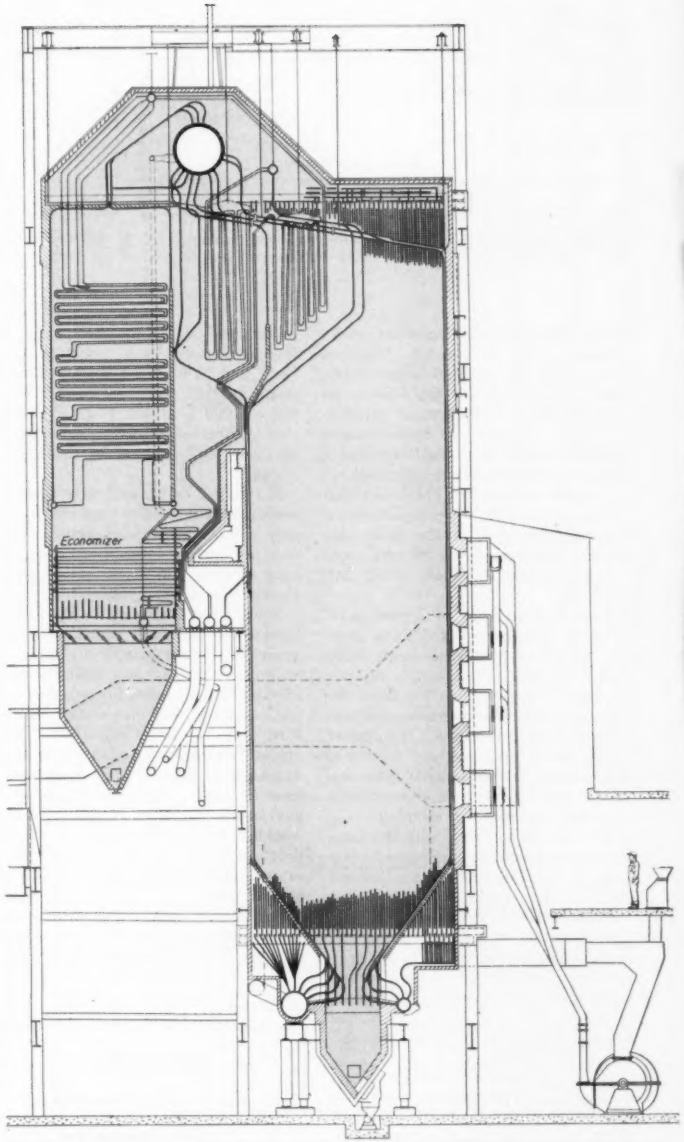
Furnace performance controls that of superheater and reheater. It also determines ultimate steam capacity and entire unit efficiency. So correctness of furnace design is the major controlling factor for a successful steam-generating unit.

We are discussing furnace design for pulverized coal and oil, but many of the factors apply equally to stoker-fired furnaces. Some important considerations in coal- and oil-burning furnace design are:

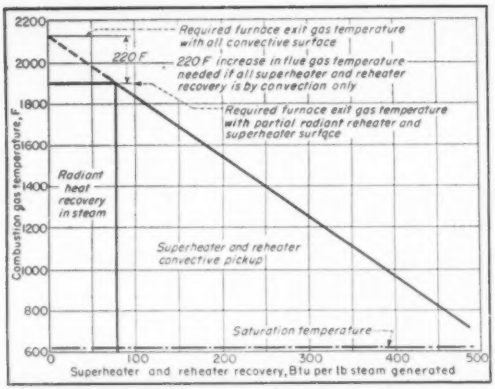
(1) Furnace shape for flame development. (2) Furnace height for completion of combustion. (3) Furnace cooling for control of furnace temperatures. (4) Burner arrangement for utilizing available furnace volume. (5) Burner elevation for control of heat in furnace-exit gases. (6) Area of furnace exit for low combustion-gas velocities. (7) Arrangement of furnace envelope for minimizing ash deposits. (8) Convenience of ash removal.

Low Ash-Fusion Designs. Steam generating unit, Fig. 1, is typical of a pulverized-coal-fired boiler designed for poorest Midwest coals. Strip-mine coal used contains over 15% ash, which fuses at 1900-2000 F. To provide enough cooling within the furnace to prevent ash fusion, heat-release rate had to be kept below 75,000 Btu per hr per sq ft of furnace envelope.

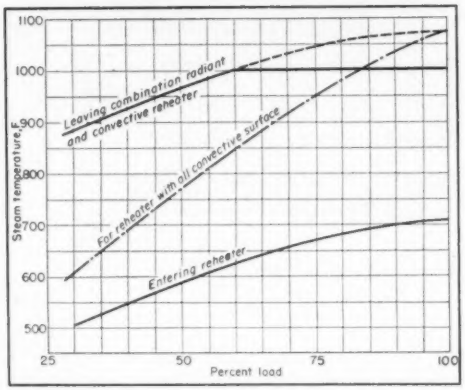
In the front wall, 16 burners are so arranged that each flame is free to develop without interference from any



3 HEAT-RECOVERY rate for varying loads is balanced by exposing part of superheater and reheater surface to radiant furnace heat and part to flue convection



4 **GAS TEMPERATURE** drop vs superheater, reheater recovery (1525 psig, 1000-1000 F), based on constant gas sp ht



5 **REHEATER** temperature gradients vs load, showing effect of combined radiant, convective surface on reheater action

other flame. This is important where slagging must be avoided. Impingement of flames on each other raises flame temperature and could cause severe unbalance of temperature distribution in the furnace. To further insure complete combustion, this 100-ft unit is one of the highest ever constructed.

Because moisture of pulverized coal often exceeds 20%, very high-temperature air drys coal in the mills. Air heater, placed interdeck between economizer sections, produces 700-F primary air.

Fig. 2 shows type of burner used. With the burning rate fixed, flame shape can be adjusted between short, bushy and long, slim. This permits full use of furnace cross section for flame development. It allows flame-shape adjustment to keep flames from impinging on walls, and insures practical control of heat pattern within furnace cross section to prevent localized high-temperature areas and resultant slagging.

Oil and gas are used with the same burners and may be burned independently or simultaneously with pulverized coal.

Superheater Effect on Design. To provide flexibility of fuel selection, unit must be designed for low exit-gas temperature. Usually this requires cooling combustion products leaving the furnace to below 1900 F to bring ash carried out with combustion gas below temperature of stickiness.

If the unit contains a superheater, or a superheater and reheater, amount of heat left in 1900-F combustion gas may be too low to heat these components by convection alone. Part of superheater and reheater surface must then be exposed to furnace radiation.

Take the 600,000-lb reheat boiler of Gadsby Station, Utah Power & Light Co, Fig. 3. This boiler delivers 1000-F steam at 1525 psig and reheats from 660 to 1000 F at 450 psig. Combination of superheater and reheater recovers about 487 Btu per lb steam generated.

If reheater and superheater surfaces were placed to receive convection heat only, and if no portion of these surfaces were exposed to furnace radiation, all heat recovered by them would come from combustion gas passing over them.

Since there is about 1.35 lb of combustion gas for each pound of steam generated, temperature of this gas unit would have to drop about 1360 F to give off the 487 Btu needed for superheating and reheating. But temperature of gas leaving the furnace is only 1900 F, and enters the superheater and reheater area at no higher than 1850 F. A gas temperature drop of 1360 F would mean flue gas leaves this area at 490 F. This wouldn't work because exit gas temperature would be 120 F lower than saturated-steam temperature of 610 F at 1525 psig.

For effective heat transfer from combustion gas to steam, the temperature difference must be at least 100 F. This means that exit-gas temperature leaving lowest temperature section of superheater and reheater should be at least 710 F. Because the required gas-temperature drop over superheater and reheater surfaces is 1360 F, temperature of gas entering this area cannot be lower than 2070 F, or about 2120 F leaving furnace. Severe slagging troubles would result if exit-gas temperature were this high, Fig. 4.

Placement Solution. Boiler No. 2 for Gadsby Station is designed for 1900-F maximum furnace-exit temperature when burning pulverized coal. Both superheater and reheater surfaces are placed to give partial radiation recovery. Example above shows radiation recovery must be equivalent to 220-F gas-temperature drop.

A superheater and reheater for combination radiant and convective heat recoveries will, of course, take advantage of natural characteristics of both. Heat-recovery rate becomes less with increasing load for a purely radiant superheater. If the two natural characteristics could be so combined that radiation and convection are in exact balance, it would be possible to hold a given steam temperature throughout a wide range of steam load without any other type of steam-temperature control.

This ideal balance is not possible because (1) furnace conditions change, (2) general design limits extent of radiant surface within furnace. So additional means of supplementary steam-temperature control are used.

If boiler-drum pressure is constant, temperature of high-pressure saturated steam entering superheater is constant.

(*Continued on page* 204)

CORRECTION

On page 97 of the June issue of POWER in "Demineralization Builds Up an Excellent-Operating Record," by M E Brines, the captions for Figures 9 and 10 should be interchanged.

Power's DATA SHEET

No. 241

Seamless Carbon-Steel Pipe—ASTM Specifications A-53 Grade B, and A-106 Grade B

Pipe size in.	Nom. OD in.	Wall thick. in.	Temperature – F: To 650	700	750	800	850	900	950
			Maximum allowable stress – psi: 15,000	14,350	12,950	10,800	7800	5000	3000
Schedule 10									
14	14	.250	330	316	285	238	171	110	66
16	16	.250	285	273	246	205	148	95	57
18	18	.250	255	244	220	183	132	85	51
20	20	.250	225	215	194	162	117	75	45
24	24	.250	195	186	168	140	101	65	39
Schedule 20									
8	8.625	.250	540	517	466	389	281	180	108
10	10.75	.250	435	416	375	313	226	145	87
12	12.75	.250	360	344	310	259	187	120	72
14	14	.312	450	431	388	324	234	150	90
16	16	.312	390	373	336	281	203	130	78
18	18	.312	345	330	298	248	179	115	69
20	20	.375	405	387	349	291	210	135	81
24	24	.375	330	316	285	238	171	110	66
Schedule 30									
8	8.625	.277	630	603	544	454	327	210	126
10	10.75	.307	570	545	491	410	296	190	114
12	12.75	.330	540	517	466	389	281	180	108
14	14	.375	570	545	491	410	296	190	114
16	16	.375	495	474	427	356	257	165	99
18	18	.437	540	517	466	389	281	180	108
20	20	.500	570	545	491	410	296	190	114
24	24	.562	540	517	466	389	281	180	108
Schedule 40									
1/2	.84	.109	1695	1621	1463	1220	881	565	339
3/4	1.05	.113	1455	1391	1256	1048	756	485	291
1	1.315	.133	1575	1507	1360	1134	819	525	315
1¼	1.66	.14	1065	1019	919	766	554	355	213
1½	1.90	.145	1005	961	868	724	522	335	201
2	2.375	.154	900	861	770	648	468	300	180
2½	2.875	.203	1215	1162	1049	875	632	405	243
3	3.50	.216	1095	1047	945	788	569	365	219
4	4.50	.237	975	932	841	702	507	325	195
5	5.563	.258	885	846	764	637	460	295	177
6	6.625	.28	840	803	725	605	437	280	168
8	8.625	.322	765	732	661	551	398	255	153
10	10.75	.365	720	689	622	518	374	240	144
12	12.75	.406	690	660	596	497	359	230	138
14	14	.437	690	660	596	497	359	230	138
16	16	.50	705	675	608	507	366	235	141
18	18	.562	720	689	622	518	374	240	144
20	20	.593	690	660	596	497	359	230	138
24	24	.687	675	646	582	486	351	225	135
Schedule 60									
8	8.625	.406	1035	990	893	745	538	345	207
10	10.75	.50	1065	1019	919	766	554	355	213
12	12.75	.562	1035	990	893	745	538	345	207
14	14	.593	1005	961	868	724	522	335	201
16	16	.656	975	932	841	702	507	325	195
18	18	.718	1005	961	868	724	522	335	201
20	20	.812	990	947	855	712	515	330	198
24	24	.937	1005	961	868	724	522	335	201
Schedule 80									
1/2	.84	.147	3030	2898	2615	2182	1575	1010	606
3/4	1.05	.154	2595	2482	2240	1868	1349	865	519
1	1.315	.179	2595	2482	2240	1868	1349	865	519
1¼	1.66	.191	1935	1851	1670	1393	1006	645	387
1½	1.90	.20	1815	1736	1567	1307	944	605	363
2	2.375	.218	1665	1593	1437	1199	866	555	333
2½	2.875	.276	1935	1851	1670	1393	1006	645	387
3	3.50	.30	1770	1693	1528	1274	920	590	354
4	4.50	.337	1605	1535	1385	1155	834	535	321
5	5.563	.375	1470	1406	1269	1058	764	490	294
6	6.625	.432	1470	1406	1269	1058	764	490	294
8	8.625	.50	1335	1277	1152	961	694	445	267
10	10.75	.593	1305	1248	1126	940	678	435	261
12	12.75	.687	1305	1248	1126	940	678	435	261
14	14	.75	1305	1248	1126	940	678	435	261
16	16	.843	1305	1248	1126	940	678	435	261
18	18	.937	1305	1248	1126	940	678	435	261
20	20	1.031	1305	1248	1126	940	678	435	261
24	24	1.218	1290	1234	1113	929	671	430	258

Pipe size in.	Nom. OD in.	Wall thick. in.	Temperature – F: To 650	700	750	800	850	900	950
			Maximum allowable stress – psi: 15,000	14,350	12,950	10,800	7800	5000	3000
Schedule 100									
8	8.625	.593	1650	1578	1425	1188	858	550	330
10	10.75	.718	1635	1564	1411	1177	850	545	327
12	12.75	.843	1650	1578	1425	1188	858	550	330
14	14	.937	1695	1621	1463	1220	881	565	339
16	16	1.03	1635	1564	1411	1177	850	545	327
18	18	1.156	1650	1578	1425	1188	858	550	330
20	20	1.25	1650	1578	1425	1188	858	550	330
24	24	1.50	1665	1593	1437	1199	866	555	333
Schedule 120									
4	4.50	.437	2235	2138	1930	1609	1162	745	447
5	5.563	.50	2130	2038	1839	1533	1107	710	426
6	6.625	.562	2040	1951	1761	1469	1060	680	408
8	8.625	.718	2070	1980	1787	1490	1076	690	414
10	10.75	.843	1980	1894	1709	1425	1029	660	396
12	12.75	1.00	2010	1923	1735	1447	1045	670	402
14	14	1.062	2010	1923	1735	1447	1045	670	402
16	16	1.218	1980	1894	1709	1425	1029	660	396
18	18	1.343	1995	1909	1722	1436	1037	665	399
20	20	1.50	1965	1880	1695	1415	1022	655	393
24	24	1.75	1995	1909	1722	1436	1037	665	399
Schedule 140									
8	8.625	.812	2385	2281	2059	1717	1240	795	477
10	10.75	1.00	2400	2296	2072	1728	1248	800	480
12	12.75	1.125	2295	2195	1981	1652	1193	765	459
14	14	1.25	2340	2239	2020	1685	1217	780	468
16	16	1.437	2370	2267	2046	1706	1232	790	474
18	18	1.562	2310	2210	1994	1663	1201	770	462
20	20	1.75	2340	2239	2020	1685	1217	780	468
24	24	2.062	2310	2210	1994	1663	1201	770	462
Schedule 160									
1/2	.84	.187	4545	4348	3923	3272	2363	1515	909
3/4	1.05	.218	4500	4305	3885	3240	2340	1500	900
1	1.315	.25	4290	4104	3703	3088	2231	1430	858
1¼	1.66	.25	3000	2870	2590	2160	1560	1000	600
1½	1.90	.281	3090	2956	2668	2225	1607	1030	618
2	2.375	.343	3225	3085	2784	2322	1677	1075	645
2½	2.875	.375	2970	2841	2564	2138	1544	990	594
3	3.50	.437	2940	2812	2538	2117	1529	980	588
4	4.50	.531	2865	2740	2473	2063	1490	955	573
5	5.563	.625	2790	2669	2409	2008	1450	930	558
6	6.625	.718	2730	2611	2357	1965	1420	910	546
8	8.625	.906	2715	2597	2344	1954	1411	905	543
10	10.75	1.125	2760	2640	2383	1987	1435	920	552
12	12.75	1.312	2730	2611	2357	1965	1420	910	546
14	14	1.406	2670	2554	2305	1922	1388	890	534
16	16	1.562	2670	2554	2305	1922	1388	890	534
18	18	1.75	2670	2554	2305	1922	1388	890	534
20	20	1.937	2655	2540	2292	1911	1380	885	531
24	24	2.312	2655	2540	2292	1911	1380	885	531

Maximum Allowable Working Pressures—I

►HERE'S THE FIRST of five handy data sheets to speed up selection of pipe sizes. These tables eliminate the ever-present hazard of errors in numerical calculations, especially when a large number of them must be made.

Tables are based on allowable stresses published in the August 1951 issue of *Mechanical Engineering*, and the p/s values published in the Crane Co catalog No. 49.

BY GEORGE C HALZEL *Boston, Mass.*

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What has caused this tremendous SWING to Riley Traveling Grate Spreader Stokers?

As more and more Riley Traveling Grate Spreader Stokers have been placed in operation Riley Spreader Stokers are being selected by greater and greater numbers of the country's leading public utility and industrial plants—to such an extent that to date in 1952, Riley has sold more traveling grate spreader stokers than all other companies combined.

We believe the fundamental reason for this tremendous swing to Riley is that news of the excellent results and satisfactory performance of Riley Spreader Stokers has traveled rapidly from plant to plant. Such satisfactory performance is largely due to design characteristics and the vast experience of Riley in the stoker field.

THE GRATE SURFACE The grate surface is made up of small clips, two inches wide by six inch pitch, mounted on structural T bars. The use of small grate clips eliminates warping and cracking and assures low maintenance and long life by providing adequate cooling. Clips are of nickel-chrome alloy to minimize growth. A level grate surface and uniform air distribution results.

THE FEEDER-DISTRIBUTOR The feeder is designed to give uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The overthrowing distributor gives uniform longitudinal and lateral distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing.

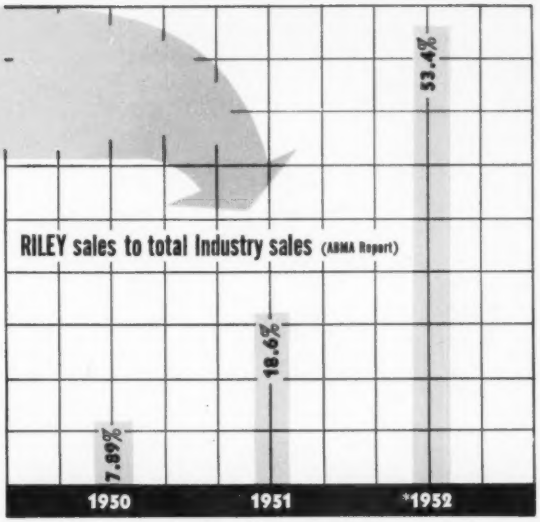
TRADE MARK Rx REGISTERED

RILEY

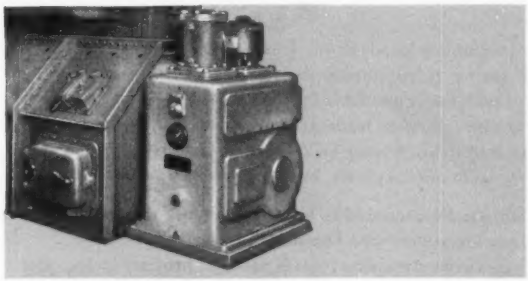
STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS



*First three months, latest available figures at time of ad preparation.



THE GRATE DRIVE The Riley grate drive is a hydraulically driven ratchet drive, completely enclosed and automatically lubricated. This simple rugged drive operates with practically no maintenance and is not susceptible to damage in case of grate obstruction. No sprockets, chains or speed reducers are required.

BACKED BY OVER 50 YEARS OF EXPERIENCE There are over 50 years of stoker designing and manufacturing experience back of the Riley Traveling Grate Spreader Stoker, dating back to the two first successful makes of stoker—the Murphy Furnace and the Jones Underfeed Stoker. Riley has been manufacturing traveling grate stokers for over thirty years.

We believe it will pay you to visit some installations before purchasing traveling grate spreader stokers.

All of these Companies have ordered Riley Traveling Grate Spreader Stokers

CARBIDE & CARBON CHEMICAL COMPANY
Whiting, Indiana
OHIO EDISON COMPANY
Springfield, Ohio—two orders
IOWA-ILLINOIS GAS & ELECTRIC COMPANY
Iowa City, Iowa
CELANESE CORP. OF AMERICA
Hopewell, Virginia
CLIFFS POWER & LIGHT COMPANY
Ishpeming, Michigan
IOWA PUBLIC SERVICE COMPANY
Carroll, Iowa
KENNECOTT COPPER COMPANY
McGill, Nevada
GENERAL ELECTRIC COMPANY
Richland, Washington
GARLOCK PACKING COMPANY
Palmyra, New York
SWIFT & COMPANY
Baltimore, Maryland
E. I. DUPONT DE NEMOURS & CO.
Savannah River Project, South Carolina
KAISER-FRAZER COMPANY
Willow Run, Michigan
B. F. GOODRICH COMPANY
Akron, Ohio
UTAH-IDAHO SUGAR COMPANY
Washington
ARMSTRONG CORK COMPANY
Lancaster, Pennsylvania
PENNSYLVANIA ELECTRIC COMPANY
Seward, Pennsylvania—three orders
OHIO EDISON COMPANY
Youngstown, Ohio
OTTERTAIL POWER COMPANY
Crookston, Minnesota
CHAMPION PAPER & FIBRE COMPANY
Canton, North Carolina
CENTRAL ILLINOIS LIGHT COMPANY
Springfield, Illinois
MONSANTO CHEMICAL COMPANY
Springfield, Massachusetts
GENERAL ELECTRIC COMPANY
Louisville, Kentucky
GAYLORD CONTAINER COMPANY
Bogalusa, Louisiana
JOHN DEERE & COMPANY
Alladin, Iowa
SWIFT & COMPANY
Charlotte, North Carolina
BROWN-LIPE-CHAPIN DIV.
GENERAL MOTORS COMPANY
Elyria, Ohio
U. S. GYPSUM COMPANY
Oakfield, New York
STOKELY FOODS
Indianapolis, Indiana
CATALYTIC CONSTRUCTION COMPANY
Fernald Project, Ohio
SANGAMO ELECTRIC COMPANY
Springfield, Ohio
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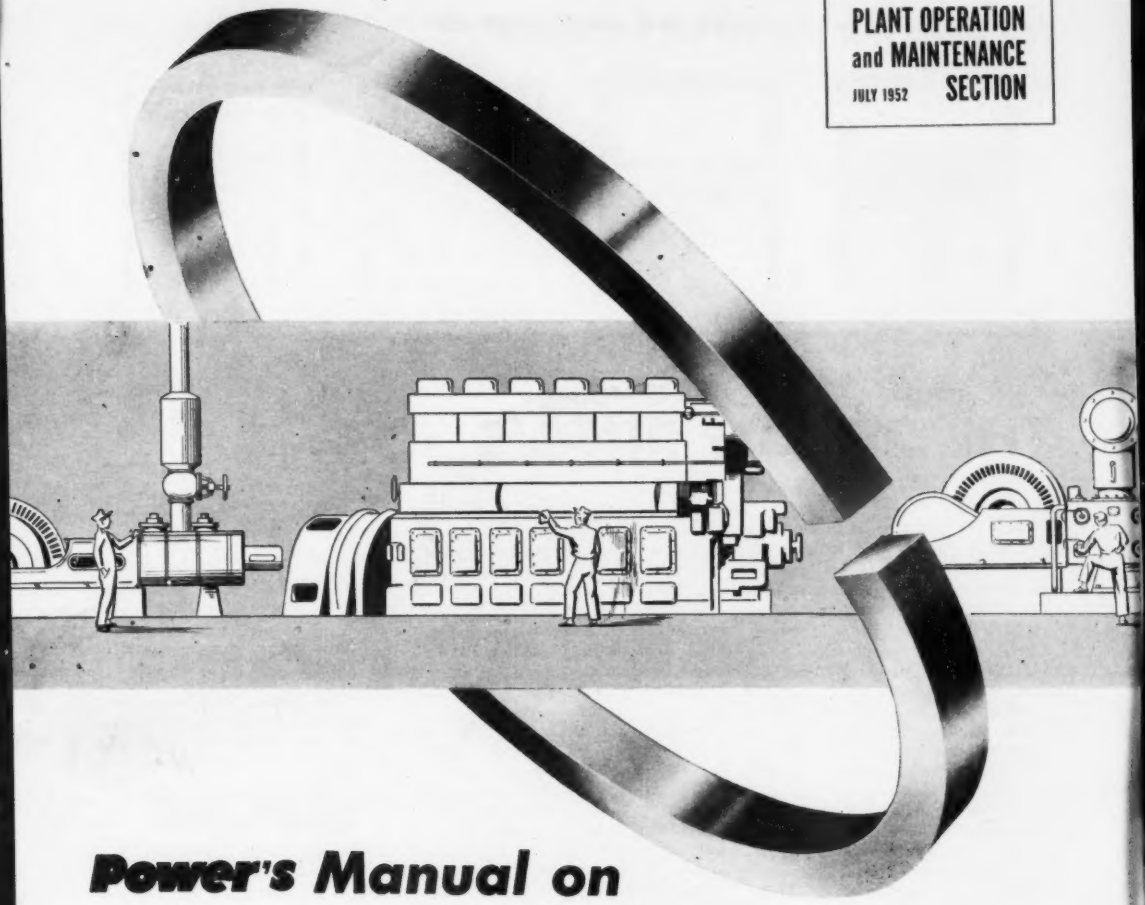


Power's Manual on

PISTON RINGS

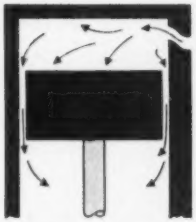
By STEVE ELONKA, *Associate Editor*

For an apparently simple device, the piston ring is mighty important. In any reciprocating equipment, good rings mean good performance, poor sealing spells trouble.

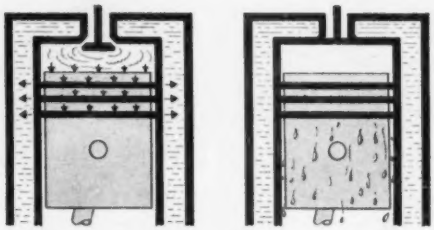
Today's machines operate at higher speeds, higher pressures, higher temperatures. All this makes life tougher for piston rings. Ring makers have countered with better materials and a great variety of ingenious designs to solve special sealing and oil-control problems.

To keep engines, compressors, pumps and other reciprocating machines running at peak performance, engineers have to know their way around in the piston-ring game. This 24-page manual is your guide—it gives the dope on the sealing problem in general, describes ring types and tells where to use them, and passes along tips on installing, operating, renewing rings and making them in emergencies.

Why pistons must be sealed and what rings do



PLUG PISTON without rings might be ideal, but piston must be made smaller than the cylinder, so needs rings for sealing



SPREADING OIL on cylinder walls is another piston-ring job. Rings also form only path for heat flow from piston to walls

THE PISTON RING'S JOB

Whether it's in an engine, a compressor or a pump, a piston works against pressure. It should form a sliding "seal" in the cylinder to keep pressure working where it's wanted, prevent it from "leaking." Such leakage always represents a loss. It may cause other troubles—fuel dilution of lube oil in diesel engines, for example.

The piston's job isn't easy. There's always pressure and usually heat. In internal-combustion engines, piston not only meets high temperature but it's in contact with burning fuel.

Simplest piston is a plug (sketch). It depends on close fit in cylinder for sealing. Plug is sometimes used in engines handling low-pressure saturated steam in newly bored cylinders. Space between cylinder walls and plug is only a few thousandths, so not much steam leaks past while plug and cylinder are fairly new. But plug won't work with superheated steam. Steam is drier, has no lubricating value; higher temperature causes plug to expand more, makes it tougher to get a close running fit.

Piston Rings. As a matter of fact, most jobs prove too tough for the simple plug piston, and that's why we use piston rings so universally. They take many forms but the basic idea is simple—a thin split ring fitted into a groove running around the piston. Ring is made with "spring" or "tension"—it tends to push out against cylinder walls, making a tight sliding fit. This keeps pressure from taking the easy path between ring and wall. Ring also pushes down against bottom of groove to make it harder for pressure to work back and underneath ring. Putting several rings on the piston increases resistance to pressure loss. Being able to expand and contract, ring can absorb differences in temperature and in cylinder bore, compensate for wear.

Oil Control. Piston rings handle other jobs besides the prime one of sealing. Usually rings help to distribute oil over the cylinder surfaces, scrape off excess. This is particularly important on engines and compressors that are splash lubricated from crankcase. This oil-control job may be important enough to provide special "oil" rings on piston.

Oil control and sealing jobs go together. If rings and piston aren't designed and maintained right, blowby will take oil off cylinder walls. Then piston gets dry and starts "scuffing." In bad cases, piston "seizes" by welding itself to the cylinder.

Heat Flow. Piston rings are major point of contact between piston and cylinder walls. If piston runs hot, as in many internal-combustion engines, and cylinder is watercooled, heat flows through rings, lube-oil film and cylinder walls into jacket water. This stacks up to a lot of resistance to heat flow. So, while transferring heat must be counted as one of the rings' jobs, it's a nice question just how much heat can flow this way through rings.

If heat conditions are tough—as in high-output diesel and gas engines—designers like to cool piston directly. This is done by letting lube oil from wrist pin spray against underside of piston crown or by circulating cooling oil from a separate circuit in space under crown. Water may be used as a cooling medium but it's not so common today. Some older engine's pistons are cooled through telescope piping.

Common Compression Rings

Standard or plain rings are made in one piece. They may be split or cut in three basic ways as shown here:

Butt Cut. Simplest, strongest and least expensive, butt joint is considered standard, but some makers class *angle* and *step* joints as "common" rings also.

Angle Cut. Angle- or miter-cut rings are made with both left- and right-hand angles. Theory of using both left- and right-hand joints on same piston is that gas blows in opposite direction through gaps and so leaks less past bottom ring. This is only a guess. Ring makers say it hasn't been proven and that 99% of angle-cut rings are sold for same angle.

Another unproved theory is that angle-cut rings have a screw action, turning slowly in ring groove. Makers claim it's also a pipe dream; designers don't count on it. Gap does open slower in use.

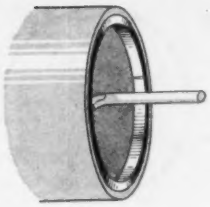
Step Cut. Step-joint rings are an old standby. Many engineers believe step joint is a perfect seal. It isn't so. Step-cut rings have no clear-cut sealing advantages. They're weaker at the joint and usually cost more.

Pressure flows behind this piston ring through side clearance and top half of gap, then out through bottom gap.

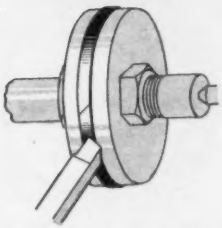
One way to make a true-circle ring

Ring is turned slightly oversize for tension, is then split

Then it's compressed into a pot of same bore as cylinder



Ring is finish-bored inside to proper dia for ring size

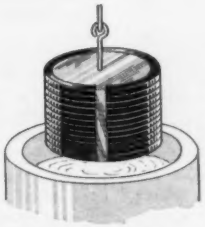


Collapsed ring is clamped in collars for the finish turning

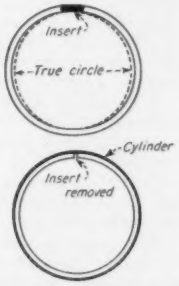
Here are some other tension tricks commonly used

Hammering forms tiny pits on inner face, spreads out ring

Some makers leave mill scale inside ring to avoid wilting



Heat shaping: rings are held open, dipped in molten salt



Insert pattern: ring, cast oval, has the insert removed

Tension—Key to Ring Performance

Ring tension can be obtained by turning rings to larger size than cylinder bore. Then gap is cut, removing enough metal to give desired tension and end clearance for the ring after it is compressed into the cylinder.

To make a true-circle ring, it must be turned to required cylinder diameter size AFTER gap is cut. Here's one way true-circle rings are made: Rough-turn casting, then rough-bore. If casting is a long "pot" instead of an individually cast ring, cut off one ring with parting tool, leaving few thousandths on side for grinding. Grind ring's sides while holding on magnetic chuck. Split ring with milling cutter, then compress into pot and finish boring inside. Press out of pot, with gap clamped closed, then finish turning outside diameter. Completed product is precision-machined ring and a true circle for cylinder it's made for. Operations are shown above.

Most manufacturers cast rings individually. At least one firm does not machine inside diameter of casting. This company claims this crust of skin keeps ring from wilting and preserves ring's tension for longer time than if mill scale on inside is removed.

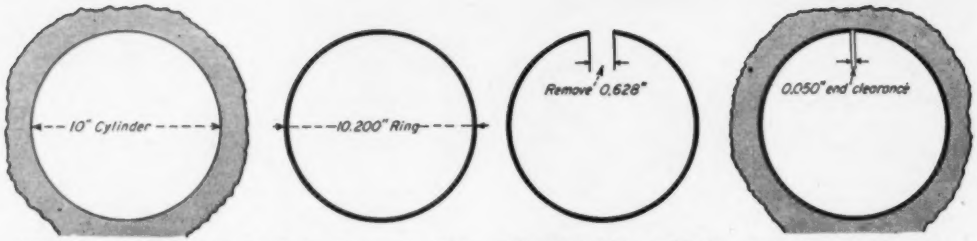
Other makers finish inside and bead or hammer ring in a special machine to add to its life. Machine controls beads and places them where they do the most good. Beads are placed closer together opposite gap and thin out as they near it. Reason is section opposite gap is under greatest strain.

Some mechanics get a similar effect when removing worn rings from machinery. Ring is placed on work bench, and beaded lightly inside with round pointed prick punch. This gives ring more tension against cylinder walls and adds to its life in an emergency, until new rings are received from maker. Caution! A careless person can distort or break a ring in this way.

Heat Shaping. Another method uses a *heat-shaping* process. Rings are held open, treated in a bath of molten salt. High temperature helps remove stresses and strains of machining operations; also, strains caused by opening ring over spacer bar. It's claimed this process has effect of "relaxing" molecular structure of metal in bath. Then rings are quenched in cooling solution at once to set metal permanently in open shape. Spacer-bar width controls ring's tension.

Insert Pattern. Still another method casts rings with an insert pattern. This casting is oval in shape. By cutting out the short insert section, the casting closes to a natural round shape when compressed into cylinder. It's claimed that *point pressure* (which means more pressure at the gap ends in ring due to tension) is relieved. Then tension is retained under high-temperature service, instead of being lost gradually.

Firm using this process casts rings individually, leaving only enough material on sides and outside diameter for grinding and turning. Then by leaving mill scale on inside, the skin or crust of casting is also claimed to help maintain wall tension needed against blowby.



ADD 0.020 in. for each in. of cylinder diameter for 10-in. cylinder's ring. That gives needed tension after splitting ring

REMOVE 0.200 in. × 3.1416 = 0.628 in. from 10-in. ring so it collapses into the cylinder. Use 0.050-in. end-clearance

Figuring Ring Tension

Before a ring can be machined for a given job, the mechanic must have some idea of tension needed to force ring against cylinder walls. But tension depends on a number of things: material ring is made of, width of face, radial thickness, etc. For homemade rings, these values usually cannot be controlled very well.

Material may be the right grade of cast iron with high graphite content. But foundry, supplying casting or pot, usually doesn't furnish material that's as closely controlled as does a ring manufacturer who specializes in this work. Then, again, homemade rings are usually made to fit into old remachined grooves on piston. That leaves only radial thickness to consider, which more or less depends on depth of groove already on piston.

With all these variables out of the mechanic's control, some rule-of-thumb formulas must be used to get a fairly suitable ring tension. Rings are turned larger than cylinder diameter, or made "oversize," and then a section is removed so ring collapses into cylinder. The problem is, What is correct oversize to make ring so it has proper tension?

Here again there is a wide difference of opinion. Practices vary anywhere from adding 0.012 in. to each inch of cylinder diameter, to adding .0.020 in. But common practice is to add 0.020 in. for rings up to 30-in. diameter. Above this diameter, add only 0.012 in.

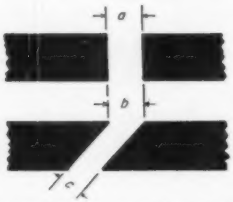
Examples. For a ring of 10-in. diameter, casting is turned to 10x0.020, or 0.200 in. larger than cylinder. Adding 10 in. and 0.200 in. gives us a finished outside diameter of 10.200 in.

For a ring of 30-in. diameter, casting is turned to 30x0.012, or 0.360 in. larger than cylinder. Adding 30 in. and 0.360 gives us a finished outside diameter of 30.360 in.

Cutting Gap. How much metal to remove in the 10-in.-diameter ring? That depends on oversize added and end-clearance needed for ring. Since 0.200 in. was added to 10.000-in. diameter, you must remove 0.200x3.1416, or 0.628 in. from the circumference. To this, add end-clearance needed for your type ring. Say, it is 0.005 in. per inch of cylinder diameter. That would be 10x0.005 in., or 0.050 in. Then 0.628 and 0.050 in. equals 0.678 in. to remove from circumference of ring.

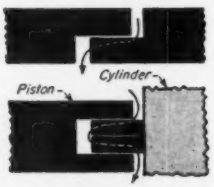
If ring is split with hacksaw, it's best to leave about 1/64 in. for filing. If split with milling cutter, remove all metal accurately so you won't have to file. Always split ring through a defect such as a blow-hole, if any.

Pointers on Common Ring Joints



Actual opening in an angle-cut ring is less than butt-cut with same clearance

Opening on left-hand ring points downward to left when ring stands on its end



Elevation and section above reveal how pressure "leaks" behind a step-cut ring

Only proven advantage of angle-cut rings is that gap doesn't open as fast as butt or step-joint. For example, while *A* and *B* in sketch are equal, actual opening *C* of angle-cut is less than opening *A* of butt-cut.

To tell if angle joint is left or right hand, stand ring upright as shown. If cut slants down toward left, it's left hand. If down toward right, it's right-hand angle joint.

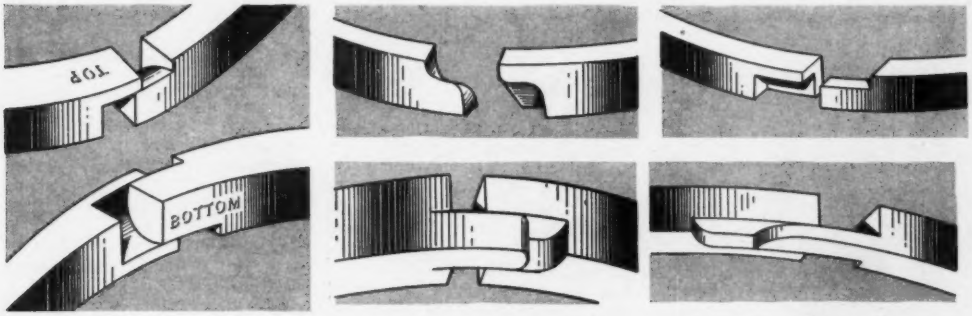
General belief is that common step-cut joint doesn't leak because stepped ends overlap. Sketch shows how gas from back of ring travels through opening at bottom. Since all three types of common joints leak, butt-cut is most popular because it's simpler and costs slightly less besides.

HANDY GUIDE TO RING TYPES

Do you know what rings to install in your equipment? If you do, you'll avoid costly troubles and breakdowns, keep equipment running at top efficiency.

The familiar "common" rings meet many requirements. But there's a whole host of rings developed to solve special problems: rings with carefully designed sealing joints to reduce blowby; multipiece and segmental rings, for a variety of jobs, combination, insert and coated rings for unusual wear problems, packing cups and rings for hydraulic pistons, scraper rings for oil control, carbon rings for nonlubricated cylinders, etc.

Some of these rings you'll find part of original equipment, others are designed to cure troubles that develop as machines grow older. You'll want to know something about all of them. The pages that follow show how various rings are constructed, for what uses they're intended and many other useful hints.

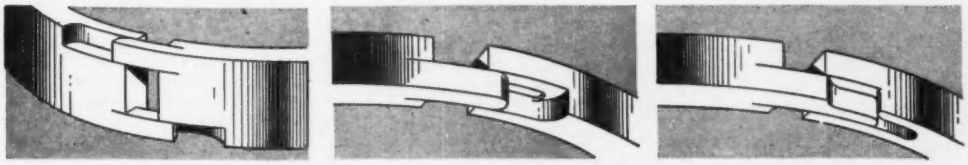


One-Piece Sealing-Joint Rings Reduce Costly Leakage

Patented sealing-joint piston-rings have come into common use. They reduce loss of pressure, especially in old worn liner. Above sketches show details of sealing joints made by various manufacturers. Principle is the same in all. In lower center sketch, ring gap is sealed by a tongue that's bonded to ring's main body. It's claimed bonding allows tongue to be flexible. Other joints shown are machined from ring.

These one-piece sealing-joint rings are effective only if installed as marked on ring, or in maker's literature. That's because pressure leaks past joint on top, as with standard rings. But joint's ends fit into each other and rest snugly on groove's bottom. It's hard for pressure to get by while joint is snug against groove and cylinder.

Use: For sealing blowby, especially if cylinders are out-of-round, worn or tapered. Also for compressors, hydraulic equipment. They combine sealing qualities of multiple-piece rings with strength of single-piece ring. Make sure groove surface against joint is true.



One-Piece Sealing, Double-Acting

If there's only one wide ring on double-acting piston or valve, use ring with sealing tongue on both sides. Pressure is sealed from both sides of ring.

Uses: For all types of double-acting steam engines, compressors, pumps, etc, where pistons are machined with only one groove. Also for piston valves.

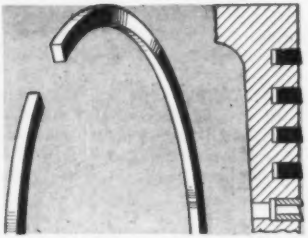
One-Piece Sealing, Double-Locking Ring

Standard rings riding over cylinder ports often break at gap because ring's ends catch slightly on port edges. With groove machined for sealing-tongue to ride in, *left sketch*, tongue is kept from springing into ports. That makes dowels unnecessary if ring groove is right width.

Another one-piece sealing, double-locking ring is shown in right sketch. Install where rings of extra-heavy radial thickness are used.

Use: For steam-engine piston valves that ride over ports, for 2-cycle internal-combustion engines, for steam pistons that need dowels. Also steam piston-valves.

Special One-Piece Compression Rings



QUICK-SEATING, tapered face helps ring seal gases in old cylinder, newly ringed

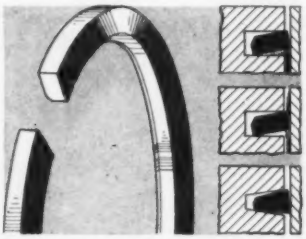
Tapered Face

Only difference between this ring and standard compression type is the slightly tapered face. In sketch, we had to exaggerate the taper because it's only few thousandths of an inch. Line contact against cylinder wall seats ring quickly since high streaks in cylinder wear the sharp lower edge fast, seating ring in much less time.

Taper also provides some oil control, especially when ring is new. Line contact is more effective than full-face contact for taking excess oil off cylinder.

Use: Good for lower compression grooves of diesel pistons.

Since this ring seats quickly, blowby is prevented at ring face in slightly out-of-round or distorted cylinders. To install right, one side is marked TOP because slight taper is easy to overlook.



CONTACTS on groove's top and bottom, as also against cyl, makes a good seal

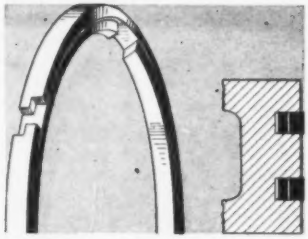
Twist Seal

Here's a new development in one-piece rings. By twisting the standard compression ring, blowby control is improved and ring lasts much longer. Twist is built in by removing metal from (1) upper corner of inside diameter, or (2) lower corner of outside diameter. This unbalance in ring causes it to twist when compressed to cylinder size. Ring then contacts piston and cylinder as in exaggerated sketch.

Contacts of high unit pressure against cylinder and piston give better seal against gases around ring's back. Line contact at its lower edge also produces better seal between ring and cylinder. Ring seats and wears in quickly. There's some oil-control action during seating period too. Keystone rings are also twisted.

Use: Recommended for the smaller, high-speed, 4-cycle diesel engines.

Multi-Piece Compression Rings



STEP-JOINT seals here because it is backed up by a second ring on the inside

Two-Piece

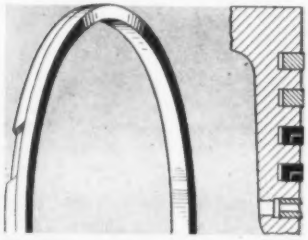
Use the simple, one-piece ring wherever possible. But for some services, rings that are made of more than one piece are needed.

Depending upon the problem, such rings can (1) be made with more tension (2) be sturdier or (3) do a better job of sealing.

This ring is made up of an outer step ring with an inner angle-cut ring. The inner ring provides tension and also seals the outer ring. This makes a good combination.

Inner ring partly shields outer ring from outward push of gases. Friction between the two rings does the trick. This 2-piece ring is about 60% thicker than a one-piece ring of the same size and wall thickness. So it must have a deeper groove.

Use: For high-pressure compressors that have fairly narrow ring grooves.



ANOTHER good sealing ring for tapered cylinder. Will fit in old narrow groove

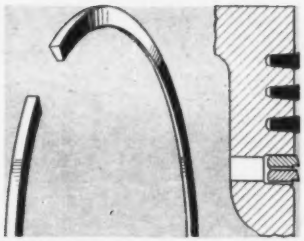
Outer Seal

This type has a master ring of L cross section and an outer rectangular sealing ring. Joint alignment of two parts is prevented by making master ring with right-hand angle joint, and sealing ring with left-hand angle joint. Rings are assembled with joints opposite each other.

Ring is made with same over-all dimension as any standard one-piece ring so special groove isn't needed on piston.

Use: Recommended on diesel engines for either new or worn cylinders. Install with sealing ring on lower side, away from pressure. Then master-ring joint is sealed.

Place two rings directly above oil rings if cylinder is tapered less than 0.005 in. per cylinder diameter. If worn more, first try the two rings. But if the compression doesn't hold, install three rings in the compression ring belt.



CARBON formation breaks up around ring from tapered sides, working in, out

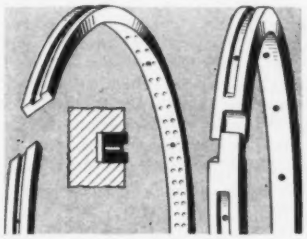
Keystone or Wedge Shaped

Except for shape, this is same as standard one-piece compression ring. Because of wedge-shaped ring and groove, ring tends to pull away from carbon and gum deposits that harden under high temperatures. This reduces ring's sticking, especially in high-output engines where top-cylinder temperature is high. Also, where there's tendency to form carbon or for gum to deposit.

Groove that ring is used in must have both sides tapered to exact taper of ring's side. Then when piston is working, ring tends to tilt slightly in groove. This breaks up carbon formation.

Another advantage is that ring is usually narrow, so the piston lands between rings can be made heavier.

Use: For compression-ring grooves of diesel that has bad carbon problem.



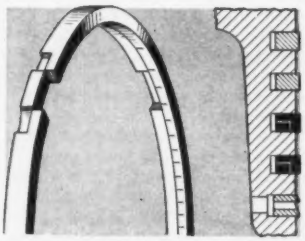
HOLES through groove help steam get in back of ring to balance the pressure

Balanced Pressure

This one-piece ring has annular grooved face, with holes through groove. Steam from ring's back passes through holes into groove or ring's face, balancing part of pressure behind ring.

Steam in face groove, which tends to blow up against the steam forcing ring down, is also about balanced. So lube oil on ring's face (cylinder-lubricated steam engines) is held on ring without blowing past. In double-acting engine, oil on the ring's lower face is retained for lubrication in same way on the return stroke.

Use: For engines whose steam is satturated or inclined to be wet, or where piston ring wears fast. Ring is also made with sealing-type joint. (To prevent breaking seal, groove does not go through it.) Used widely in corliss and marine engines where steam is saturated, where lubrication is important.



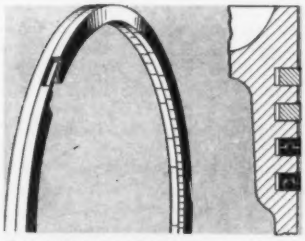
STURDY compression ring has a sealing piece and can be used in the old groove

Inner-Seal Type

Outer L-shaped ring and rectangular inner ring with sealing lug. Together, the joints of two pieces are staggered and lug on inner ring projects into recess at joint of outer ring. This seals the joint. Install with inner piece downward, away from pressure in combustion chamber.

This type has same over-all size as one-piece ring. It can be used on pistons without enlarging their grooves. Two parts, not interchangeable, must be installed together with L-shaped ring against pressure as shown.

Use: For internal-combustion engines of 5-in. diameter or over. Use two rings placed directly above oil ring, with two standard one-piece rings above. Inner member must be downward, away from pressure. Use three rings if the cylinder taper or out-of-roundness is over 0.005 in. per in. of cylinder diameter.

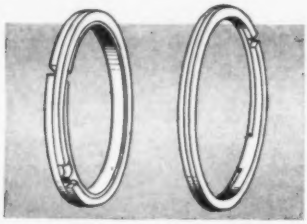


TOP AND BOTTOM rings are said to be held apart by the gas and oil pressure

T-U Type

So named because one ring is T-shaped, the other U-shaped. Because each ring has overlapping joint, pressure cannot get past. Side clearance between tongue and groove of each allows both rings to contact cylinder. Top and bottom clearances between tongue and grooves give oil and gas pressure a tendency to hold pieces apart, against ring groove's top and bottom. Thus, ring seals pressure from getting past ring, also from getting behind it. Either T- or U-piece can be placed on top.

Use: On diesel and gas engines. Place in lower compression ring groove on single-acting, center grooves on double-acting piston. Place joints together as one-piece ring and expand over piston. Hold one ring at joint, turn over ring so joint comes to groove's opposite side.

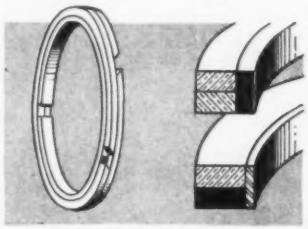


TWO PIECES seal each other, yet ring is flexible and fits into the old groove

Two-Piece Ring With Sealing Joint

Left sketch shows master ring L-shape cross section and sealing ring of square cross section. Lug machined on L-ring keeps the sealing part from turning. Then the gap of two members cannot line up to allow gases by. Sealing ring seals gap against cylinder wall, also against piston groove's bottom. Ring guards worn or new cylinders against pressure loss. It's made of same cross-section dimensions as common type of plain snap-ring. Ring at right is for same service but has slightly different details. Both are for same use.

Use: Air or gas compressors; gas, diesel, or steam engines; steam and vacuum pumps; various hydraulic equipment. Especially adapted for worn, tapered and out-of-round cylinders that are difficult to seal.



THREE-PIECE job has bronze or bronze and iron face rings, iron or steel back

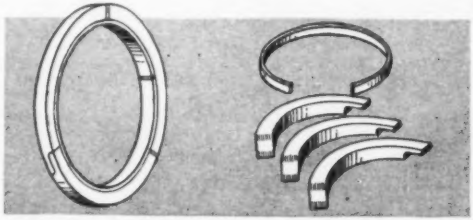
Three-Piece Compression: One Inner, Two Outer

Ring has one straight-joint steel inner-ring and two quick-seating iron or bronze outer rings, with opposite angle joints. Inner ring gives tension and seals outer ring joints.

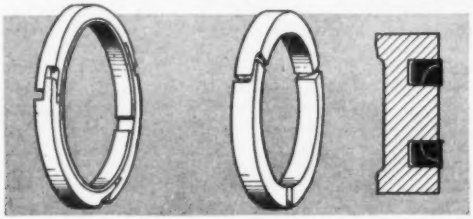
Opposite-angle joints won't line up in service. So outer rings are not pinned to inner ring.

Friction between inner- and outer-rings prevents excessive wear on cylinder and rings. Ring wall is about 60% thicker than standard one-piece ring. Ring is flexible, conforms to out-of-round and tapered cylinders. Compression is held in either direction of stroke.

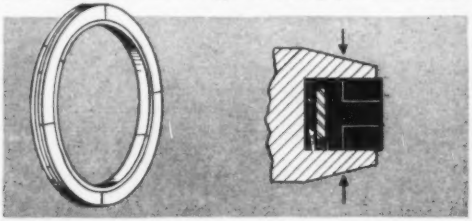
Use: For double-acting compressors where sealing is needed both ways or for piston using only one heavy ring.



SEGMENTS make this a flexible ring for some heavy-duty services because ring seals well against out-of-round cylinders



ANOTHER SEGMENTAL construction is similar to that shown in preceding sketch but the type of sealing joints is different



TWO-WAY SEALING makes it possible to use only one ring on a double-acting piston. Side rings are doweled to T-shape ring

Four-Piece Compression Rings

Three rings in first and second sketches at left are of three sections, each having an overlapping end to form sealing-type or step joints. Three segments fit together to form a complete circle. Steel expander ring inside segments presses the assembled ring against cylinder walls.

Segmental design permits using a much heavier ring wall than is possible in a one-piece ring. Because ring is made of pieces, there's no springing to do over the piston, so any thickness needed for job can be used. Because ring is thicker, it gives long service before wearing out, especially for tough service in heavy-duty machinery.

Another advantage is that ring conforms to worn cylinders because it's more flexible than a thick one-piece ring.

Use: For service that causes rapid wear, such as natural gas, hot oil and tar where lubrication is limited or abrasive matter is present in large quantities. These rings have been used for natural gas up to 5000 psi. For double-acting jobs, install on piston so each ring seals in opposite direction.

Two-way sealing, 4-piece ring, sketched at bottom (left), has a center one-piece T-shaped ring and two flat outside rings. Each outside ring is in four segments and pieces are doweled to T-shaped ring. Doweling keeps ring joints from aligning with center T-shaped ring's joints. Ring seals in both directions. A steel expander ring in the back adds tension for holding ring against cylinder walls. T-shaped and side-rings are made of Gun Iron, which is a dense wear- and pressure-resistant iron. This material is widely used for diesel liners especially for marine use.

Use: Double-acting air pumps, compressors and steam engines. Makers advise machining land between two rings on old piston and installing only this one 4-piece ring.

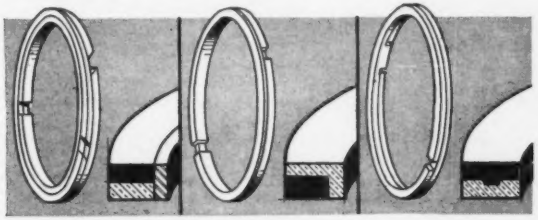
Recommended for out-of-round or tapered cylinders because segmental design conforms to such cylinders more easily than thick one-piece ring for heavy-duty service.

Bronze and Combination Bronze-Iron Rings

Reason for making rings of bronze is chiefly to resist corrosion. Bearing bronzes, containing percentages of lead and nickel, are also used where ring lubrication is poor.

These rings are also used where there's corrosive action from machines operating at intervals. Cast-iron rings may corrode and "freeze" in such service, causing unit to fail when needed most. Some classes of bronze resist the corrosive action of both organic and inorganic acids, as well as many other chemicals in solution or in gaseous form. Many of the cast-iron ring types shown in this article can be furnished in bronze to suit service requirements.

Use: Water pumps, valves, special pumps handling acids, air and gas compressors are some of the more common applications—also many unusual uses not mentioned here.

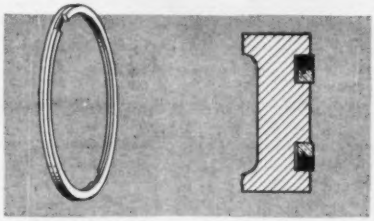


Two- and Three-Piece Rings

Combination bronze and cast-iron rings are used because bearing qualities of cast bronze are combined with heat-resisting qualities of cast iron. These rings quickly polish cylinder wall and lessen scuffing and scoring. Then piston ring and cylinder life is greatly increased from these favorable conditions.

In service, the bronze member tends to deposit a thin coating of bronze on the cylinder wall. The iron member absorbs oil and carries it along to help lubricate the cylinder. Because cylinder gets highly polished over entire ring-travel area, there's a reduction in wear.

Use: Compressors, steam engines, pumps, and hydraulic cylinders, where wear is excessive and lubrication becomes a problem.



Three-Piece Bronze and Iron

Sides of cast-iron and bronze rings fitting together are grooved for steel restraining ring. Restraining ring allows two main members a slight radial movement so they can seat-in independently of each other. After members are seated-in, restrainer helps them wear uniformly.

Use: Any type internal-combustion engine, steam engine, pump or compressor where piston grooves are wide. For diesel engines of high temperature, place ring only in lower compression-ring groove. Standard sealing rings in upper grooves of same piston are usually recommended.

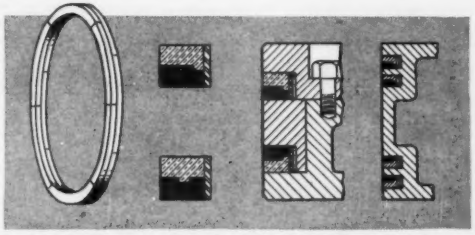
Sectional Bronze-and-Iron Rings

Bronze and cast-iron members of these rings are made in sections. Because ring has bimetal members, it combines wearing and burnishing properties of bronze with heat-resisting qualities of cast iron. Number of sections in ring varies with cylinder diameter, ring style and application.

Ring is made of either two L members, or one T and one U member. Tension is from spring expander made of heat-resisting alloy steel used on inside of segments.

Applications shown are for typical follower-type piston, also for uniflow-type piston. Install as shown.

Use: Steam engines where lubrication is a tough problem.



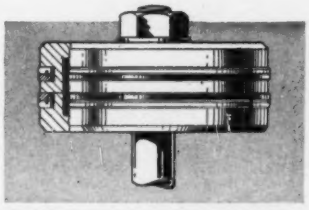
L- AND T-SHAPED rings of bronze mate with cast iron. Two of ways such combination rings can be applied are shown at right

Sectional Ring With Expander-Restrainer

Ring is made up of bronze and cast-iron segments. Segments are pressed outwardly against cylinder wall by an expander made of heat resisting-alloy spring steel. V-groove formed by inside beveled edges helps retain lubrication.

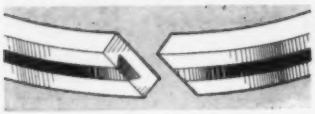
Because of segmental construction, ring is flexible enough to take care of out-of-roundness and taper in cylinder. Overlapping segments form a continuous seal that prevents steam leakage. Lubrication is retained.

Use: Industrial and marine steam engines where the conditions are severe. Ring is old standby on larger engines where outage for repairs is costly.

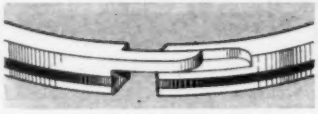


RETAINER RING in center helps hold together bronze and cast-iron ring pieces

RING TYPES *continued*

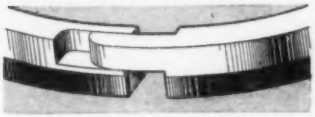


Standard angle-cut with bronze

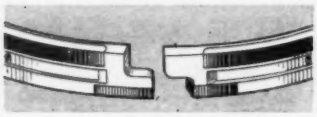


Sealing joint with bronze

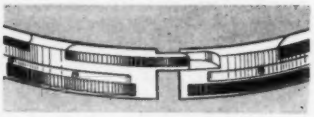
One-piece, bronze sealing tongue



One-piece, alloy sealing tongue



Balanced pressure, step joint



Balanced pressure, sealing joint

Insert-Metal Rings for Quick Seating

Insert rings have one or more bands of so-called "anti-friction" metal inserted around cast-iron rings. Bands project about 0.002 in. beyond cast-iron face. Metal is permanently bonded into ring's body. Dovetailing or some other anchoring method keeps insert from working loose.

In cylinder, high unit pressure on narrow softer band seats ring quickly. This helps prevent blowby. As insert metal wears, it burnishes cylinder wall to mirror-like surface so cast-iron body seats very gradually. Then bi-metal combination tends to eliminate scuffing and reduces wear on both piston ring and cylinder.

Another advantage claimed for soft insert band is its high thermal conductivity. Band speeds heat flow from the piston to the cooled cylinder wall.

Use: *Standard angle-cut ring* shown may have one or more bands of soft metal inserted. It, and the *bronze-insert ring with sealing joint*, may be used for refrigeration compressors, compressors for high-pressure and high-temperature air, steam, gas and diesel engines.

One-piece ring with bronze sealing tongue may be applied on slow-speed ammonia, gas and air compressors, or steam engines.

Ring with alloy sealing tongue and bonded bronze band to protect both cylinder wall and piston groove from rapid wear finds use on compound air and gas compressors, above 1000 psi. Also on steam engines operating with superheated steam at 250 psi or more. Sealing tongue is made from a special alloy material that is claimed not to break in service.

Balanced-pressure rings, with inserted bronze sections on both sides of groove, are made with either step or sealing-type joint. They're applied only when a heavy piston ring is needed. For older type stationary, marine and other steam engines, this heavy ring will not compensate for excessive wear caused by previous operation.

Insert of white-metal bearing material is used in another type of quick-seating ring, not shown. These rings are used to prevent excessive cylinder wear and scuffing. Low melting point of white-metal insert limits such rings to low-temperature air and refrigerated compressors. Before ordering, it's best to check with ring manufacturer.

1 Magnified smooth surface is rough

2 Oil molecules keep the surfaces apart

3 Oil molecules thin under heavy load

4 High pressure load ruptures oil film

5 Antifriction coat fills in rough pits

Coated Rings Stop Costly Scuffing

BECAUSE the rings and cylinder can be permanently damaged when starting newly ringed engine, ring's seating surface is important. First, ring must seat quickly. If not, gases blow past and erode face of ring and cylinder wall, making condition worse with machine's continued use.

When rings get little oil (boundary lubrication), scuffing and scoring results. Metals reach melting heat traveling over dry spots. Ring welds to cylinder, breaking away instantly as piston travels. This is scuffing.

After ring seats quickly, it must wear slowly. No matter how highly cylinder is polished, its surface looks rough under a microscope, Fig. 1, above. Surfaces tend to grip one another, unless separated by enough lube oil molecules.

If enough oil can be forced between surfaces, Fig. 2, there's no metal-to-metal contact. But as higher pressure and heat raises friction load, oil-molecule layers thin out, Fig. 3. At very high pressures and temperatures, as with top diesel piston ring, oil film tends to rupture, Fig. 4, causing metal surfaces to touch.

By coating piston-ring's rough surface with a so-called anti-friction bearing material, tooth-like surface fills. Ring quickly takes on a "mirror finish." Then oil film reduces friction, Fig. 5.

Quick seating coatings are in three classes: (1) phosphate (2) oxide and graphitic (3) soft metal such as tin, cadmium or lead plate.

Phosphate coatings help cast iron get a hard surface and also hold needed lube oil. So layer of iron phosphate must break before scuffing can start.

Oxide and graphite coatings give ring a finely etched surface, with tiny pits filled with graphite. Graphite soaks up oil so dry spots retain enough lubrication to prevent scuffing for long periods. Many types of compression rings are graphite coated. This treatment provides a film of graphite to assist ring and cylinder through break-in

period, until the sealing surfaces mate.

Soft-metal coatings of tin, cadmium or lead melt under scuffing conditions. Molten metal serves as temporary lubricant. Soft coatings are only 0.0003 to 0.0005-in. thick.

Bearing-metal-coated ring is one-fourth hardness of iron, so seat forms quickly. Cylinder pores and slight scratches fill fast, take on a "polish." Such coated rings are for heavy-duty compressors or steam engines where wear is severe.

Chrome plating is a fourth type of coating. Chrome is deposited electrolytically from 0.004 to 0.006 in. thick. One firm makes outside of chrome porous, for retaining oil, while other firms use only hard chrome. Surface of porous chrome stays several hours, then wears off so hard chromium contacts cylinder. Chromium cuts down scuffing.

Under tough dust and sand conditions, chromium plated-rings have increased ring and liner life many times. With only the top ring plated, wear of all rings and cylinder wall is reduced.

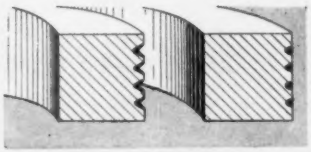
Brinell hardness of cast iron runs from 200 to 300, that of chrome ranges from 1000 to 1200. Because cylinder-liner wear costs more than ring wear, cylinders of larger engines are often plated instead of plating the rings.

Tin- and Chemical-Filled Rings

Tin-filled ring is a newer development for 2-cycle diesel engines. Ring has deep grooves partly filled with tin. Part of groove not filled with tin fills with carbon during operation. Carbon absorbs oil and helps ring during poor lubrication. Then if ring gets overheated from poor lubrication, tin melts and prevents scuffing.

Chemical-filled ring has grooves filled with a porous chemical, baked into grooves. Filler absorbs oil. Oil is released during marginal lubrication, absorbs oil during good lubrication.

Use: Both types of rings are for 2-cycle diesel engines. Because two-cycle diesels are valved by piston at cylinder ports, oiling top rings is problem. Chemical-filled rings have operated a million miles in locomotive diesels.



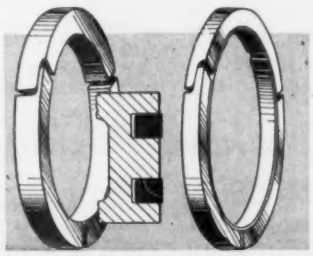
TIN partly fills grooves, melts if ring needs oil. Space fills with carbon that absorbs oil. Chemical, *right*, soaks oil

Non-Metallic Rings for Corrosive Jobs

Laminated plastic offers good resistance to corrosion and wears well in piston rings. Rings are made of one piece or as outer rings for 2-piece and 3-piece compression rings. Joints are either step or seal type, depending on service.

Segmental rings shown have compression inner-rings of corrosion-resistant steel. One-piece rings (not shown) have enough tension without inner rings. Rings are made of laminated bakelite, laminated phenolic graphitic, graphited bakelite, or a high-temperature bakelite. Used up to 275 F, while high temperature is good for 350 F.

Use: Pumps and compressors handling corrosive hot or cold water, oil, gasoline, mild acid solutions, natural gas, etc, also gritty solutions. Rings cannot be made to as close tolerances as can metal rings. Unless applied for right uses, rings swell from oil or moisture absorption. Or sheets may separate under high heat. Materials made up of canvas sheets are more successful than those with asbestos sheets because bond is less apt to separate in service.



LAMINATED BAKELITE comes in segments with sealing-type and other joints, may have a metal expander in back as shown

Rubberized-Cotton Packing for Pistons

This piston packing is a combination of cotton-fabric plies, treated with rubber, and muslin-covered at the top and bottom.

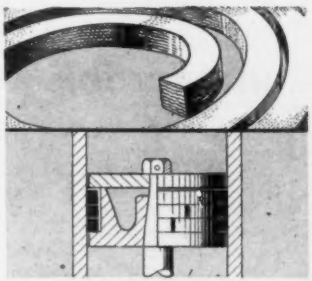
For boiler-feed pumps where water is 160 F or above, packing is cured rockhard. Soak hard packing in hot water overnight, then it's soft enough to bend around piston before sawing to right lengths.

Lightweight duck for cold water is treated with rubber-compound, finished with duck covers. This packing is flexible, no soaking needed.

How to Install. Use packing with 1/32-in. clearance between plunger and pump cylinders. Then liquid can get under packing to hold it tightly against cylinder.

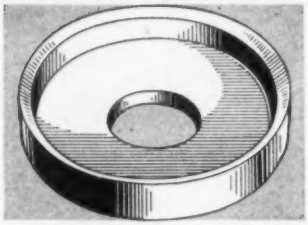
Bend packing around plunger and cut with hack saw to 1/16-in. end clearance. If no side clearance between last turn and follower plate, rip thin plies from packing's side for 1/32-in. clearance. Without side clearance, packing swells endwise against follower plate. Then it acts as a solid plug and leaks around outside diameter. Packing must float on plunger to be successful. Be sure to stagger packing ends around piston.

Use. Hot or cold water, on piston or plungers. Or use as anti-extrusion end-rings with other softer packings.

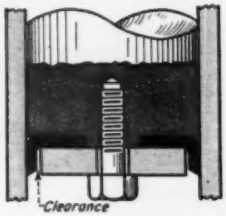


SOFT OR HARD packing strips are cut so there's clearance in back and sides. The packing floats so pressure helps seals

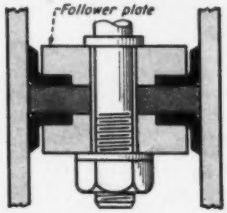
CUP-PACKING installed as shown here seals tightly against fluid pressure...



MANY materials are used to make cups, providing dynamic as well as static seal

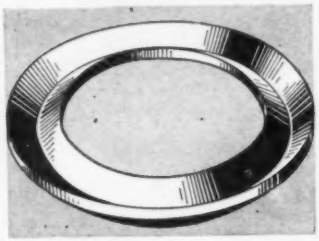


FLUID in clearance between the follower plate and cup lip holds cup to cylinder

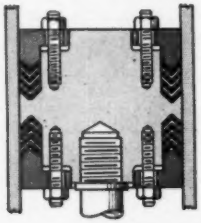


FOLLOWER plate thickness must come up to inside bevel of the cup's sealing lip

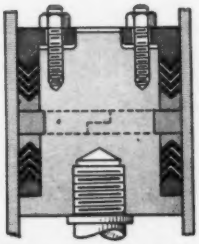
V-PACKINGS nested together offer several sealing lips



EFFECTIVE for both high and low pressure, V-packing is a very popular type



EACH SET of rings works independently on common piston in double-acting job



ANOTHER double-acting piston design for V-rings is packed from only one end

Molded Packing for Pistons

LEATHER Mechanical leather packings are used to operate under very high pressure. Leather is well suited for hydraulic and pneumatic application. For low pressure, leather is treated with oil, grease or soft wax. For high pressure, it's impregnated and can be made rock hard.

For piston packing, leather is used in three common shapes: cup, V and U. Cup's base is secured to piston. Then side wall provides a sliding fit in cylinder. Clearance between inside of cup and follower plate allows liquid to force leather against cylinder, providing a dynamic seal.

Use. For water; for vegetable, mineral, fish and animal oils; for alcohol, air, oxygen, glycerin, gasoline, kerosene or any other noncaustic, nonacid fluid for various pressures.

In closed hydraulic systems, a soluble oil and water emulsion is often used to eliminate rusting and pitting metal parts, also to provide some lubrication. When using leather for this service, be sure soluble oil emulsion is as near chemically neutral as possible. That means pH at 7.0. CAUTION: Don't use leather to seal acids, alkalis or steam. Where oil is pressure medium, specify oil-resistant leather.

For very low pressures, or when sudden pressure changes come on, the liquid may bypass the cup's lip. Avoid this by using some type of metal expander to hold the leather against cylinder at all times.

Three most common types of expanders are shown at top of page 115. Each ring is held in a groove machined in the

Combination Rubber and Phenolic Rings

Sealing member and retainers make up ring assembly of five parts. T-shaped sealing member is synthetic rubber. It's backed on sides by retainer rings, which are split. They are made of laminated phenolic material.

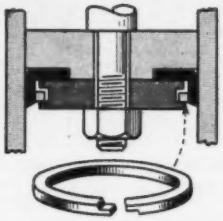
Pressure of liquid in cylinder causes resilient synthetic rubber member to flow, forcing retainer rings against cylinder wall, which prevents the extrusion of synthetic rubber sealing ring. Thus it does excellent job of preventing leakage past the piston.

One advantage is piston grooves need not be highly finished; but use honed cylinder for long service life.

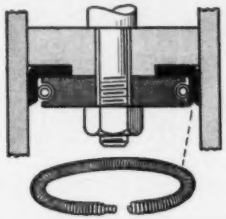
Use. Hydraulic or pneumatic systems. Can be used to pump kerosene, lubricating oil, gasoline, water, fuel oil, and other fluids. For temperatures from –70 F to 250 F, use for any pressure. Tests have been run at 50,000 psi.

5-PIECE has four split phenolic rings and one synthetic rubber sealing ring

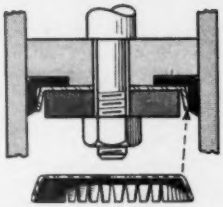
...while metal expander helps seal against very low pressures



SOLID compression ring fits in groove around follower plate, presses cup's lip

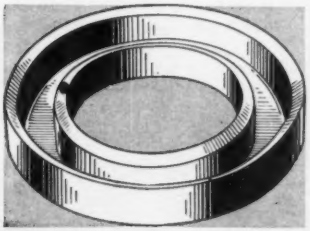


COILED SPRING fits in rounded groove, is another popular type of expander ring

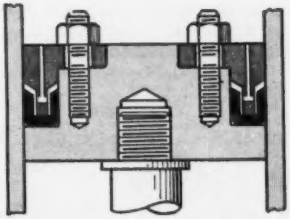


FINGER-TYPE expander needs no groove, is clamped under follower plate as shown

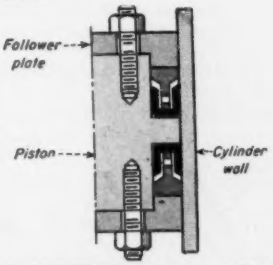
U-PACKING does good high-pressure sealing, easy to install



BALANCED pressure on all inside surfaces seals the piston in every direction



PEDESTAL ring, holding U-packing, drilled so that liquid is forced against sides



DOUBLE-ACTING pistons over 100-in. diameter are packing sealed as shown

inside follower plate. One is a thin metal cup designed to fit inside leather cup. Its lip is a series of fingers, shaped to maintain packing lip in sealing contact with cylinder wall.

Temperature range for leather is sub-zero to 200 F.

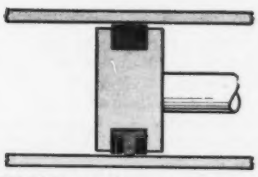
Maintenance Tips. Remove leather packings in machinery that's shut down for long periods during year. Place packings in rigid forms so they keep their shape. If used in water, dry leather thoroughly; oil after drying.

Keep abrasive sediment out of hydraulic cylinders. In system using water as a pressure medium, a soluble oil prevents cylinder wall from corroding and lubricates working parts. Install filters in closed hydraulic system where same pressure medium is used over and over again.

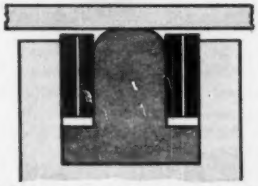
FABRIC Cup packings shown are also made of fabrics, combined or frictioned with one of many special compounds made of rubber or synthetic rubber. Cup's material and type of compound depend on nature of service.

Use. Fabric cup packings are recommended for air at high or low pressures and against oils on heavy-duty hydraulic equipment. For service against oil, use a lightweight cotton fabric that is frictioned with a special neoprene compound.

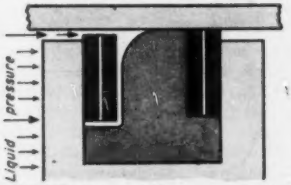
For heavy-duty service against oil, use a strong cotton duck that is frictioned with a special neoprene compound. For heavy hydraulic service, use a strong cotton duck that is frictioned with a special rubber compound suited for job. Cups are made of numerous materials to suit most services.



ASSEMBLED on piston, the elastic ring is supported by the phenolic retainer rings



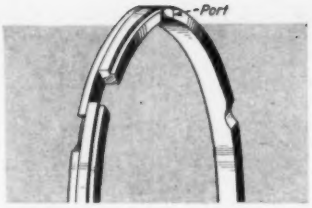
AT REST, this elastic ring fits snugly against cylinder while retainers float



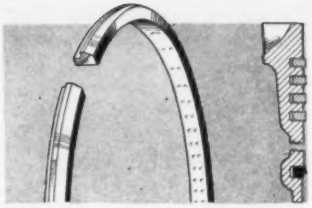
WORKING piston builds pressure against plastic ring, lifting retainers in back

RING TYPES *continued*

QUICK-SEATING oil scraper spreads oil on up stroke, removes it on down stroke



PORTS help gas press ring against the cylinder; sealing-type joint stops the oil



SHARP-EDGED scraper groove removes most oil possible if you have oil problem

BEVELED Simple one-piece quick-seating oil ring, butt, angle or step cut, and beveled with narrow bearing face to cylinder. On up stroke, ring rides over oil, spreading a thin film around cylinder. On down stroke, ring scrapes off excess oil. Install beveled side up. Machine a groove below oil ring for drainage.

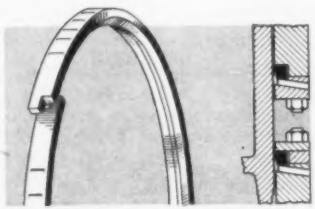
Use: Any type piston where scraping ring is needed to remove oil, but especially for 2-cycle diesel engines.

SEALING PORTED One maker claims most oil is lost through oil-ring gap on suction stroke. Sealing joint prevents oil passing through gap. As ring scrapes oil down, seal is against groove's top.

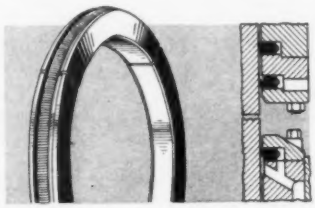
Use: Vertical, moderate speed, 4-cycle internal-combustion engines, all classes single-acting compressors. Use two or more on piston's lower groove, below piston pin if there are drain holes in piston, or above pin if none.

GROOVED This quick-seating ring has beveled upper edge and undercut corner groove around lower. Ring rides over oil film, scraping maximum of oil on down stroke. Should have some form of oil relief under ring, or reduced piston-skirt diameter under ring.

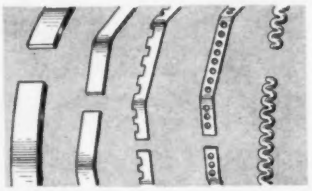
Use: Install in either horizontal or vertical internal-combustion engines and compressors, especially if oil consumption is heavy or hard to control.



SCRAPING EDGE is on inside diameter of ring in cylinder. It hugs piston skirt



SPRING holds the ring segments against piston. Ring placed in cylinder groove



FLEXIBLE EXPANDERS of various designs are placed in back of rings for tension

CONTRACTING This large one-piece, concentric ring bears evenly all around against piston skirt. It's used in a specially constructed groove at bottom of cylinder to scrape oil from long piston trunk. Inside scraping surface is made plain or beveled and grooved, as needed.

Use: Place in 2-cycle diesel engines that carry oil rings in cylinder instead of on piston. Hold in place with bolts.

FOUR-PIECE Segmental, contracting ring is made in many forms. Segments are held together by a garter spring, placed in groove around ring's outside. Clearance between segments allows spring to hug pieces against unevenly worn piston skirt and scrape oil from its surface. Ring comes with various-shaped scraper edges to suit individual needs.

Use: For 2-cycle diesel engines.

EXPANDERS Severe oil pumping calls for more unit pressure against cylinder. Steel ring in back of oil ring does job, also helps to cushion piston slap. As ring diameter increases, thinner and more flexible rings can be used with expanders.

Use: For serious oil problems, behind oil rings in high-speed diesels. Also for compression ring in out-of-round cylinders where groove depth is right.

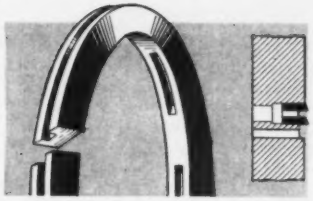
Oil-Control Rings, Plus Application...

Piston rings have two basic jobs: (1) sealing against pressure loss (2) controlling oil by scraping off excess on down stroke, distributing oil around cylinder on up stroke.

Lube oil gets on cylinder surfaces in various ways, whether machine is splash- or pressure-lubricated. Oil leaks out of main-, crank-, and piston-pin bearings. It may also be agitated by crank hitting oil in crankcase. In most cases there's a dense fog of oil vapor in crankcase. Rapidly revolving and reciprocating parts tend to throw oil droplets against lower part of cylinder liner each time it's uncovered.

Unless oil, not needed for cylinder and piston lubrication, is scraped off, it may be drawn up into combustion chamber on suction stroke, while there's a partial vacuum above piston. Then it burns during combustion stroke. Besides being wasteful, this tends to carbonize piston-ring grooves, cause ring sticking. For this reason, oil-control rings are usually put on piston. On larger diesels, ring might be of contracting type, placed in the cylinder.

Similar problems exist in other engines, and compressors, without added complications of internal combustion. The de-



WIDE SLOTS between the double scraping edges help oil drain freely through ring

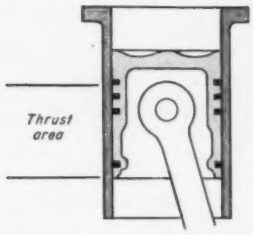
SLOTS and removed bottom scraping edge are for piston having no undercut groove

VENTILATED ring has grooved face, with slots cut through groove for draining maximum oil from upper scraper edge. Both scraper edges are beveled on up side, leaving narrow wearing face for quick seating at bottom. This ring also comes with seal-type joint.

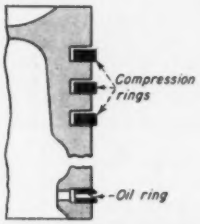
Use: For moderate- to high-speed vertical engines of small bore. Used where cylinder-oil control is no special problem.

SCRAPER, VENTILATED Quick-seating ring has only one scraper edge. Has bevel on upper edge, corner groove on lower outer edge, with oil passages from groove through ring. Oil passes through slots, then holes in piston. No undercut needed on piston.

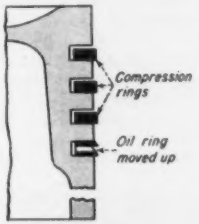
Use: Mostly in large vertical oil and gas engines, both below compression ring belt and at piston's bottom end.



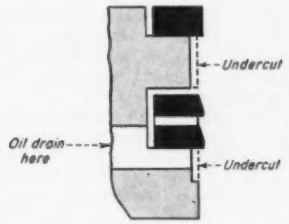
1 Piston skirt, cylinder wall take thrust if engine hasn't crosshead



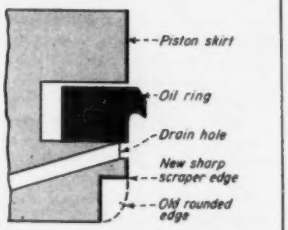
2 Oil ring at skirt bottom may remove oil needed in the thrust area



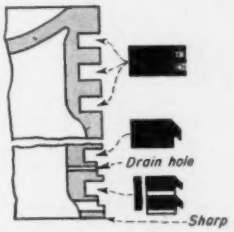
3 Moving oil ring up under compression rings may help to spread oil



4 Undercut metal from piston (dotted lines) so oil may drain away



5 Sharp-edged groove at skirt bottom will help in oil-removal job



6 Rings and piston shown help control oil on the tough 2-cycle jobs

...Know-How, Help Cut Down on Cylinder Oil

signers of reciprocating machinery know how very important it is to get good cylinder lubrication. But they can't anticipate all the conditions an engine or compressor must work against. The result is an oil-control problem for the plant engineer. The following pointers deal, in the main, with diesels, but they show some of the ways oil problems can be solved and many of the basic principles apply to other types of equipment.

Thrust Area. Most modern engines don't have crossheads to take side thrust of the crank and connecting rod. So piston (and its rings) thrusts against cylinder wall, Fig. 1. It's this thrust area that must be lubricated without fail.

In some 4-cycle engines, oil ring is at bottom of piston. This may cause marginal lubrication of the upper part of the thrust area; compression rings may not spread all of the oil and oil-ring's position keeps it from spreading oil beyond a certain point. Moving this ring up under compression-ring belt, Fig. 3, helps distribute oil to upper part of thrust area without starving piston skirt below.

Oil Drainage. But placing oil ring in right spot isn't the

whole story. For ring to work right, there must be a groove or undercut around piston both above and below oil ring, Fig. 4. Make undercuts just deep enough and wide enough to handle volume of scraped oil, without removing too much support from land under rings. Also drill oil-drain holes all around piston in back of oil ring to drain inside of piston. Don't drill holes too high. Have centerline of hole split bottom surface of oil-ring groove. Then holes will drain oil from in back of oil ring and also from undercut around bottom of oil ring.

Oil-Hole Tips. Drilling holes is no problem if pieces of old rings are wedged into oil-ring groove to build up surface so it's even with piston surface.

Many modern diesels don't have oil grooves at bottom or top of ring. Sometimes holes aren't drilled to drain undercuts. Then oil builds up under rings on down stroke. Because oil can't escape, ring may collapse and ride over all oil.

So operator installs ring with more tension and sharper scraping edges. It's harder on the cylinder and ring still collapses. Solution to a potentially costly problem like this often lies in some simple detail like grooves and drain holes in right places. With them, original rings can do the work they were designed to do.

Undercutting. Why does piston need undercut between bottom compression ring and oil ring? Reason is that compression rings do some distributing of lube oil for their own use. Bottom compression ring scrapes most oil and it must be allowed to escape so it doesn't collapse ring.

Some pistons have two oil rings at bottom of skirt. If oil control needs to center there because of some design feature, it's often possible to make one ring do the job. It's just a case of using the piston's bottom edge for an oil ring, Fig. 5.

Using Skirt Edge. If piston skirt has rounded edge, remove it by machining a sharp groove. This protects scraping edge from damage when piston is out of cylinder. Such a sharp edge will scrape enough oil so that remaining oil ring near bottom can swing the original job of two rings.

Piston skirt edge scrapes oil effectively, doesn't depend on tension and can't collapse.

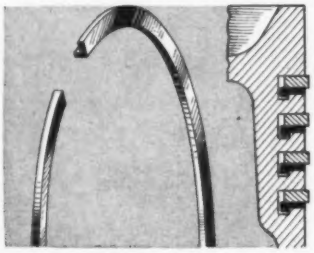
2-Cycle Engines. Pistons running in ported cylinders present different problems. Here oil rings are usually near skirt's bottom to keep oil out of exhaust ports. But sharp lower piston edge and undercutting around oil rings often proves good practice here also, Fig. 6.

If scavenging-blower pressure is high, it may be a good idea to place a combination compression and oil ring above present oil ring. That helps to insure against blowdown from airbox to crankcase.

Since oil rings at skirt's bottom must control all oil without much help from compression rings at top, oil rings on ported jobs usually have to exert higher unit pressure. Like Fig. 6, they're often used with a steel expander.

Compression rings on 2-cycle engines may get less oil than those on 4-cycle engines. It often helps to use rings of the oil-carrier type, Fig. 6. Annular grooves on the ring's wearing face are filled with an absorbent non-metallic material. This filler soaks up oil at bottom of liner and pays it out over hot spots when needed.

If compression rings are right type for individual engine, three should prove enough on most 2-cycle pistons.



WEAR occurs on ring inserted in groove; ring is replaced, saving costly piston

Wearing Rings

While a wearing ring is not for sealing, it's an important part of the piston-ring assembly where needed. This ring is placed below piston ring and locks in a special groove, so it cannot spring out against the cylinder. Thus, it's actually part of the piston and takes the wear of groove's lower surface.

Useful piston life is lengthened because wearing rings outlast several sets of piston rings. Without wearing rings, a piston's grooves may have to be machined each time new rings are installed. Piston ring lands are thinned with each machining. Large expensive pistons are often scrapped for this reason, even though in good condition otherwise. As wearing rings wear, just renew them instead of the entire piston.

Use: Install wearing rings on large diesel and gas-engine pistons where there's excessive groove wear.

Dowels

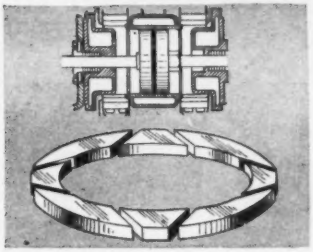
To prevent ends of piston-ring joint snagging in ports of some cylinders, rings are made with dowel hole. Dowels are placed in ring grooves so the ring-ends ride across port bridge, instead of across ports. This is especially important where ports are all around cylinder walls. Doweling prevents ring from turning in slot and eventually breaking off ring's ends.

If your engine's pistons need doweled rings, locate dowels in upper half or pressure side of groove. See that dowels are strong enough to withstand shearing action of ring.

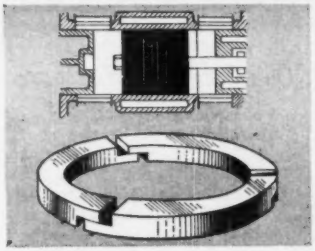
Always place dowel holes in ring near joint. Otherwise, piston ring is weakened and may break through the dowel hole. Designs shown are for some of the more common types of dowel pins. Always make sure pins are brazed tightly into piston.

Use: Two-cycle internal-combustion engines, uniflow steam engines, and some types of pumps and compressors.

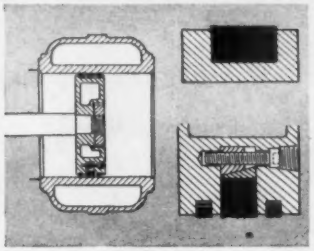
These Carbon Rings and Pistons Deliver Air That Is Free Of Oil



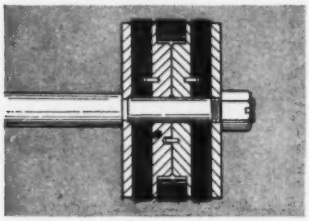
METAL PISTON: supported on both ends so only carbon ring contacts cylinder



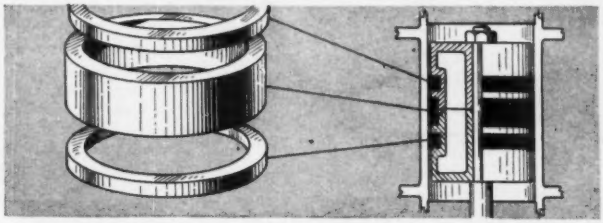
PISTON and rings are both carbon because horizontal piston has no tail rod



RIDER RING is carbon, can be adjusted to keep heavy piston weight off cylinder



TURN piston slightly from time to time so rider rings don't wear down to piston



VERTICAL PISTON: in two parts so wide one-piece carbon rider ring can be replaced. Sealing rings on both sides float freely in piston grooves

Carbon Rings

Carbon piston rings are used wherever cylinders cannot be lubricated. A common application is in compressors supplying oil-free air in plants processing food, beverages, etc, where air may come in direct contact with the product. Even least amount of oil in compressed air would discolor, spoil or affect the taste of product.

Carbon rings are also used in process work to handle steam, oxygen, CO_2, hydrogen sulfide, etc.

Construction. Because carbon-graphite is self-lubricating, it is used bone-dry in cast-iron, monel and other cylinder liners.

Carbon rings are made to various specifications. Transverse breaking strength varies from around 3000 psi on softer materials up to 10,000 psi in harder, more dense material.

Usually the harder and higher strength materials go into compressor rings. Crushing strength varies from around 3000 to 35,000 or 40,000 psi. This carbon material is an electrical conductor and nonmagnetic.

Common design is segmental. These rings usually have a metal expander ring inside, pressing segments against cylinder wall. Shown above is a segmental ring used on a "floating" piston supported by piston and tail rods. Shaft packing rings are also carbon. They keep oil off rods entering the cylinder.

Carbon Piston. In a cylinder without lubrication, contact with cylinder wall must be made only through self-lubricating carbon. Floating piston design is one way of making sure that metal of piston can't touch cylinder walls even when carbon rings wear. Another scheme makes the piston itself out of carbon-graphite. Usually lap-joint piston rings go on such pistons, which are made longer than normal.

Rider Rings. Still another design makes use of rider rings—wide bands of carbon-graphite surrounding a metallic piston. The rider rings center piston in cylinder, may be made adjustable to take up wear. Vertical piston shown above has a rider ring between two butt-joint carbon rings for sealing.

In one horizontal design illustrated above, rider ring is made in segments and has an adjustment for wear. Hollow-head setscrew in end of piston works a wedge that forces carbon shoe against cylinder, lifting piston away from the wall. Small segmental carbon rings with metallic inner-spring expanders give proper wall pressure.

OPERATION

For trouble-free operation, cylinder must be honed and polished to a very fine finish. Tiniest rough spot in cylinder will groove carbon rings. Because there is no oil to help seal rubbing surfaces, leakage past tiny groove grows progressively worse, causing a bad blowby condition.

If carbon rings wear badly, look for faulty operation. For example, don't circulate cold water through cooling jacket of nonlubricated cylinder. If you do, moisture in air inside cylinder condenses. Water rusts liner, causing rough spots that wear carbon fast. Instead of turning on cooling water before starting machine, heat water to 100 F or more to prevent condensation.

Run machine on bypass control so you won't have to start and stop it frequently. Then cylinder won't cool as it does during shutdown.

Rotate the piston about a third of a turn every few months of operation. If piston has a rider ring that keeps metallic parts from touching cylinder walls, turning piston increases ring life by equalizing wear.

Dust in cylinder is a common cause of carbon-ring failure. Use a good air filter on intake side, and keep it properly serviced. Dust acts as an abrasive, wears out both rings and liner quickly.

As much as 15,000 hr of trouble-free service has been chalked up on nonlubricated air compressors by following these simple operating rules carefully.

MAKING EMERGENCY RINGS

1—Why Is 2-Cut Ring Right; One-Cut Wrong?

TWO-CUT RING (*black*) forms perfect circle, while one-cut ring (*gray*) goes to egg shape

Sooner or later, most engineers get into a spot where the only answer is a homemade ring. And all too often the "quickie" ring spoils what was a good cylinder. That's because rings are turned and bored to finished dimensions, split and put on the piston. Such "one-cut" rings wear cylinder egg-shaped. Even worse, there's so much leakage that blowby removes cylinder lubrication, causing scuffing and pressure loss.

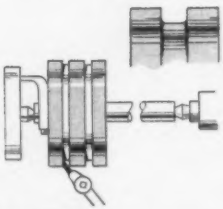
If you must make rings in an emergency, make them in two cuts as shown here. After casting is rough turned and bored, cut gap and wire ring shut. Then finish turn, while ring is collapsed. That makes a "2-cut" ring.

Slide ring into smallest part of

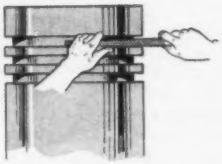
ONE-CUT RING leaks badly on both sides of gap, wears the cylinder out of round

cylinder; check the gap clearance with feelers. Remove and file until clearance is correct, to keep ring ends from butting when heated to working temperature. Butting causes ring to wipe oil from the cylinder, piston to seize.

3—Preparing Piston Groove and Ring

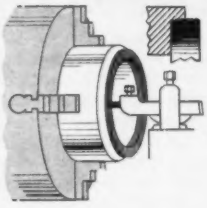


OLD GROOVE in piston wears wedge-shaped, has filled-in corners. Remove carbon, make sides parallel for the ring



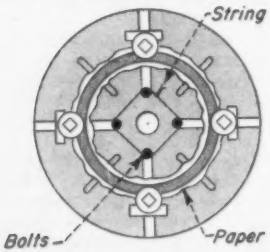
CARBON from the large piston groove is cleaned with an old dull file or a scraper. Don't remove any of the metal

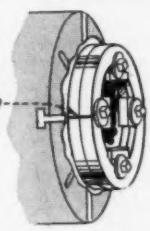
TRY RING in groove by rolling it around piston. This shows tight spots in groove or if ring needs more facing

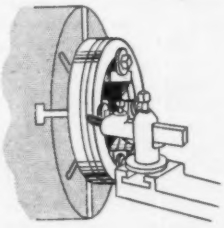


TURN A SEAT in casting from which ring was cut. Tap ring into it snugly. It serves to hold ring while facing side

5—Finish Turning and Boring (Second Cut)

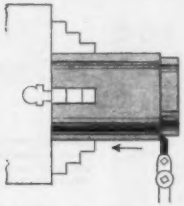




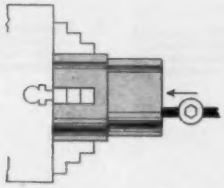


PLACE FACEPLATE on workbench. Slide four bolts in slots and tie them with string for later use. Put heavy paper on plate and pile collapsed rings, centered as well as possible. Have gaps over slot. Clamp rings down from outside with another set of bolts and washers. Attach plate to head stock, loosen bolts and true-up rings. Take finish boring cuts. One at a time, remove outside bolts and clamp with inside bolts. With outside clear, remove wires and take light cuts to finish OD

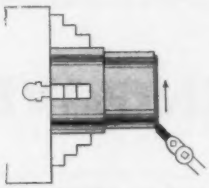
2—Roughing-Out the Ring (First Cut)



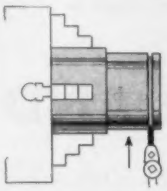
FIRST STEP: Know cylinder diameter. Figure oversize for tension and gap clearance, then add enough for finish turning. Sketch shows taking rough cut after truing-up casting



ROUGH BORE casting to size such that there is enough metal left for finish boring after ring is collapsed. Take boring cut deep enough to get under mill scale, or tool dulls fast

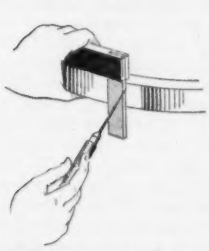


FACE END of casting after rough turning and rough boring. Turn cast iron slowly. *Caution!* Beware of fine cast-iron dust blowing into eyes. It's painful to get out. Wear your goggles

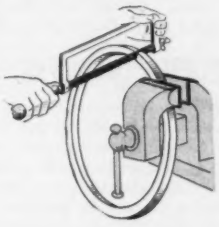


CUT OFF roughed-out ring with cutting-off tool. On long casting you might have to run tailstock against a block of wood resting against casting. That prevents chattering on this job

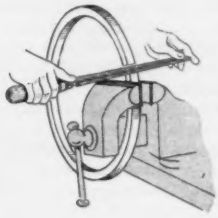
4—Sawing, Filing and Collapsing



SCRIBE guide marks for sawing out gap. Figure on removing enough metal to give tension needed in the ring



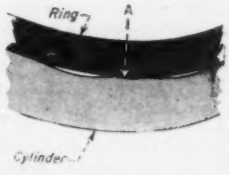
CLAMP in vise between copper jaws and cut gap with hacksaw, if you've no miller. If ring has flaw, split at flaw



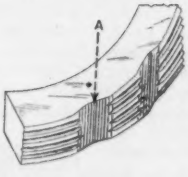
FILE saw ends parallel. This is not finished job as ring is only rough turned, bored. File only to scribed marks

COLLAPSE ring by twisting a soft iron wire around. This does job of expensive cylinder and clamp makers use

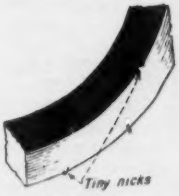
6—Leave Tool Marks on Ring, Handle Carefully



GROOVES worn in cylinder allow blowby, removing badly needed oil on walls of newly ringed cylinder. This may cause scuffing and eventual failure of ring

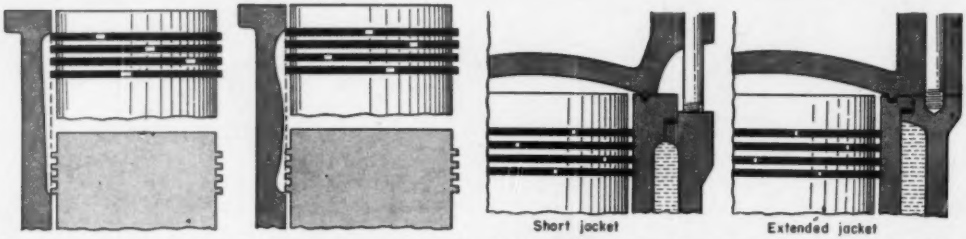


TOOL MARKS left on finished ring, wear quickly into slight grooves and irregularities of most cylinders. Smoothly finished rings take longer time to seat



CAREFUL HANDLING of any new ring pays. Nicks and burrs can score cylinders, or keep ring from seating. Remove them before putting any ring into its groove

Here's how cylinder liners wear and how design of liner may affect cooling...



1 Most wear at top, liner tapers gradually downward

2 Most at top, less wear at bottom, least in middle

3 Water jacket extending above top-ring travel (*right*) helps to carry away heat from troublesome upper part of cylinder

LINER AND PISTON RING-WEAR

High pressures and temperatures and exposure to firing, make wear conditions in internal-combustion cylinders tough. The following deals with such engines, but many of the principles apply to other engines and to compressors.

LINER WEAR

Internal-combustion cylinders often wear like Fig. 1, with maximum wear at upper end of ring travel. Cylinders also wear as in Fig. 2, heaviest at both ends of the ring travel.

Some things affecting wear are: bad atmospheric conditions, dust in intake air (no filters, or filters not working), corrosive fuels (high sulfur or sulfur-gas content), etc. For example, experience shows that sewage gas with high hydrogen-sulfide content is tough on ordinary iron.

Liner Material. Standard material for diesel and gas engine liners has been gray cast iron. This material has the needed casting and machining qualities. Its wear resistance and anti-scuffing ability are superior to most materials. At times, nickel, chromium and molybdenum may be added to further improve iron's qualities.

Both cylinder liners and piston rings are usually made of gray cast iron because experience shows this material withstands wear even when not lubricated well. One belief is that graphite in gray iron acts as a lubricant. Others say percentage of graphite is too small to have any effect. Some makers raise the graphite content because they argue that graphite forms microscopic pits which absorb and hold oil. Graphite pays out this oil when lubrication is weak.

During the break-in period of a new liner, there's a tendency to wear and scuff, depending on the original finish. Scratch-honed surface is best. Honed finish cuts down on friction while tiny scratches fill with oil-soaked carbon.

IRON FOR RINGS

You can't order a cast-iron "pot" from a local foundry, machine it into rings and expect them to hold up like manufactured rings. Simple reason is that to meet today's tougher ring jobs, making piston-ring castings is highly specialized.

Today, rings are usually narrower, tension must be better controlled. Rings must be tougher to hold their shape, they need more resistance against breakage and they must wear better. It's no longer enough to make rings of "a good grade of cast iron."

Ring makers do a lot of research to find out qualities needed and ways to build them into ring metal. Rings are cast statically or centrifugally, with varying graphite contents. Long "stringers" of graphite that weaken rings have been done away with. Today, some rings have the graphite in nodular form, which increases toughness. Such graphite particles are also held to increase wear resistance.

What does all this improvement in ring materials mean to the user? Ring breakage is reduced. Higher unit pressures can be used without distorting narrower rings. Better control of tension and circularity helps reduce blowby and hence cuts cylinder wear while adding to ring life.

PLATED CYLINDERS

With metal shortages and high manufacturing costs, worn liners are too expensive to scrap. Chrome plating is used to attack this problem in two ways: (1) new liners plated with chrome are recommended to slow down wear rate, and (2) old, worn liners may be restored with plating.

These advantages are claimed for chrome: liner and rings both wear longer, chromium has low coefficient of friction, excellent corrosion resistance, extreme hardness, high melting point, good thermal conductivity. Porous plating is said to give a surface with numerous tiny oil reservoirs.

Instead of plating piston rings (which are smallest wearing parts), the larger and more expensive liners are plated. Engine purchaser can request plated liners in a new unit, or liners from an existing engine can be shipped for rebuilding and plating. Cost of latter is generally less than that of a new replacement liner.

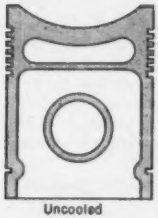
In rebuilding, worn surfaces of old liner are first machined to get rid of ring steps, fluted wear, scoring. Then metal is built up to original diameter with iron deposited electrolytically. Variations in bath composition and plating conditions can vary plate characteristics as needed. Cylinder is next honed and chrome-plated to a thickness of 0.003 to 0.015 in., depending on service needs. Finish honing gives a mirror-like surface on chrome.

COOLING AND WEAR

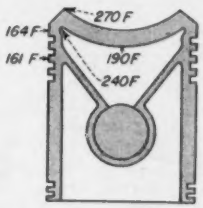
Top ring on piston is forced against cylinder wall at 300 to 1200 psi and works in an atmosphere where gas temperature can hit peaks of 3000 to 4000 F.

Oil fed to the top rings runs very thin. And most oil gets burned off almost as soon as it's spread on hot cylinder wall.

...and how piston design can affect life expectancy of rings



4 Heavy uncooled piston crown (*left*) may be hard on rings. Oil-cooled piston (*right*) keeps heat away from ring area



5 Low temperatures shown on well-designed piston

Before you start to do something about liner and piston - ring wear, you must know what causes wear, also what affects the temperature of the piston and rings

So top ring often starves for lubrication. Rings can work in these impossible sounding conditions only if adequately cooled. So if top rings don't stand up take a look at cooling effect near upper part of cylinder first.

Jacket Design. Fig. 3 shows how a relatively short water jacket can fail to fully cool the top ring area. In Fig. 4, typical of many modern engines, jacket is extended to carry away heat from troublesome upper ring zone. Better cooling cuts down cylinder and piston-ring wear.

PISTON COOLING

In older non-cooled pistons, metal through crown was usually thick, Fig. 4. Heat absorbed by the crown had to travel through piston walls to ring zone, through rings and oil film to cylinder wall and thence to the cooling water in the jacket. This isn't an ideal path for large quantities of heat and in many cases piston rings got excessively hot. Top rings often failed because ring-belt temperatures ran as high as 500 F.

Where heat loads are heavy, today's engine designers provide a positive means of heat removal. One type of piston cooling is shown in Fig. 4. Crown and ring zone is cooled by lube-oil sprayed from top of connecting rod. This design, and similar cooled-piston layouts, lowers temperature of entire ring belt. If carbon and scale on underside of crown is removed when engine is overhauled, rings get all cooling possible.

To show how temperatures can drop on well-designed engines, readings were taken on a 2-cycle 14-in. piston, Fig. 5. At 300 rpm and 62 bmep, hottest part of crown was only 270 F and ring area was only 161-164 F.

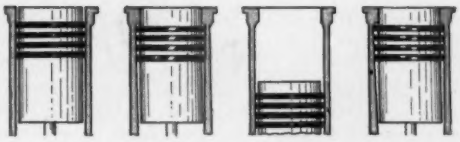
RING WIDTH

Width of piston ring's rubbing surface on wall affects wear rate of liner and rings. Careful laboratory tests show that with narrower rings there's less piston-ring and cylinder wear.

Pressure ring exerts against wall is sum of pressure caused by gas behind the ring and tension of the ring. For any given tension, unit pressure tends to be the same regardless of ring width. But wearing area is larger on wide ring, smaller on narrower ring.

Pressure of lower ring against wall is little more than spring tension of ring, unless ring above leaks and some gas pressure acts behind lower ring. But a narrow ring seals better because it is more flexible and follows contour of cylinder wall.

Taking advantage of all things mentioned here that can slow up liner wear, you should be able to hold liner wear to not more than 0.0003 in. per 1000 hr of engine operation.



TAPERED CYLINDER wastes fuel oil since ordinary rings cannot seal its compression and combustion. Seal types do better

Sealing Badly Worn Cylinders

Laboratory tests have been made on badly tapered diesel cylinders to find sealing effect of various type ring joints on engine performance. Rings with sealing type joints were especially helpful in stopping blowby in slow-speed large-bore diesels running at 100 to 300 rpm.

While end clearances are negligible in unworn cylinder (*A*), they open wide in a worn cylinder (*B*). Because most wear occurs at liner top, which is point of highest pressure, there's more blowby with ordinary ring-gap.

But you can't use rings with less end clearance in a tapered liner because minimum clearance must be at smallest cylinder diameter (*C*). When piston travels to top, rings are open so wide they lose quite a bit of compression.

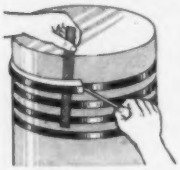
If a cylinder has a 0.060-in. taper, for example, the ring opens up 3.14 times 0.060, or 0.188 in. So if it's not practical to rebore liners or renew them, obvious solution lies in using rings with joints to seal blowby. Tests show that blowby is almost stopped with sealing-type rings if grooves are right so rings seat properly (*D*).

Piston Speed. It's interesting to note that the slower the piston travels, the more time there is for pressure to blow past rings. By same reasoning, the faster the piston travels, the less time for blowby, all things being equal.

Loss of compression can be an expensive waste just as is loss of pressure on working stroke. If air leaks past rings on compression stroke, there's less air to burn fuel properly, less temperature to ignite it. That leads to poor combustion and wasted fuel. One ring maker claims fuel consumption increases due to lower compression range from 5¾% with 10% lower compression, to 11¾% with 45% lower compression. They claim solution is rings with seal-type gaps.

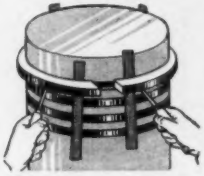
INSTALLING, RENEWING RINGS

How to Remove Old Rings



PRY ring's end and slip brass strip underneath

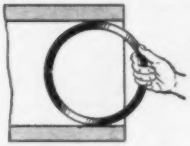
SLIP brass strip under other end after prying



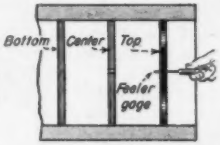
SLIDE ring over crown with strips all around

How to Fit New Rings

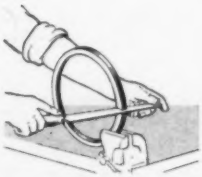
FIRST remove shoulders from both cylinder ends



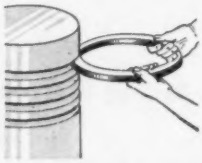
COLLAPSE ring into cylinder endwise as shown



TAKE end clearance with feeler in three places



FILE ends for clearance at minimum cylinder bore

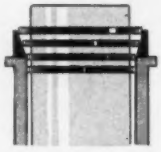


ROLL completely around groove for tight spots

CLEAN groove; give rings the right side clearance

EXPAND ring's free end over crown as pictured

DON'T spring costly ring by handling it carelessly



TAPERED pot on cylinder collapses the rings safely

When should you renew piston rings? That depends on the kind of equipment the rings are used in. Operating conditions, materials in rings and cylinder, lubricant used and method of feeding it to cylinder surfaces, all make a difference. So there's no cut-and-dried answer to this ring question.

One large ring manufacturer finds, for example, that a plain open-joint ring in the upper groove of a diesel piston lasts about a year under normal conditions. Many operators prefer to go by changes in end clearance. A rule of thumb calls for changing piston rings of butt, angle or step type when end clearance increases to about three times original clearance. This rule applies for all types machinery ring is used in.

Diesel rings that aren't changed when they need it allow hot gas to blow past ring ends and burn lube-oil film off cylinder wall. After that begins, both cylinder and rings wear rapidly. But rings with sealing-type joints seem to last longer, especially in worn or tapered cylinders, because ends overlap, and clearance isn't so important.

Some operators keep a chart as a guide for changing rings. After each 1000 hr of operation, they check ring clearance and record wear. Then time to change can be estimated fairly accurately, based on past performance.

Various signals serve other operators. Loss of power is a good tipoff. It can be detected by using some form of indicator to check compression and combustion pressures. Pressure loss is also shown by increased fuel consumption, excessive fumes or even an audible hissing noise. A sharp rise in consumption of lube oil is another good indicator. Also watch exhaust—continuous dark-blue smoke spells trouble.

Another indication that rings may need renewing is hard starting. This may be result of low compression temperatures growing out of pressure loss.

Right Run-In Pays on Newly Ringed Engines

Avoid wrecking newly ringed diesel by: (1) underlubricating (2) overloading (3) overheating, and (4) allowing rings to contact cylinder walls unevenly.

Underlubrication causes metal-to-metal contact between rings and cylinder. Then metal surfaces scuff (welding together momentarily as ring travels). Engine idling at slow speed for long time during run-in causes underlubrication. Splash-system engine doesn't get enough oil at slow speeds.

First make sure oil level (if splash) is higher than usual because rings need more oil during run-in. Next, run engine at normal speed until temperatures are about normal.

Step up load at set intervals and increase speed at same time. CAUTION! Heavily loaded engine at low speed scuffs new rings quickly. High-speed during run-in is just as bad. Rings and engine overheat, thinning oil on cylinder. Overheating for long also causes gum and varnish deposits, sticking rings. Before running-in, overhaul injection system so combustion is right and rings are not harmed from that cause.

Load enough to cause wear of piston ring against cylinder. If not, rings skate, leak compression and do not control oil. Blowby removes oil from walls and rings scuff.

Rings in all machinery need more oil for run-in period.

Follow these clearances if you don't have manufacturers' recommendations

TABLE I: COMPRESSORS AND STEAM ENGINES

Compressors

Diameter, in.	Minimum side clearance, in.	Minimum end clearance, in. Step and straight cut joint	45-deg angle joint
Below 6	.0015-.0025	.003 x Dia	.002 x Dia
6 and over	.0025-.004	.003 x Dia	.002 x Dia

Steam Engines—Saturated Steam

Below 6	.002	.005 x Dia	.003 x Dia
6 to 12 15/16	.003	.005 x Dia	.003 x Dia
13 to 25	.004	.005 x Dia	.003 x Dia
Over 25	.004	.125 total	.075 total

Steam Engines—Superheated Steam

Below 6	.003	.008 x Dia	.006 x Dia
6 to 12 15/16	.005	.008 x Dia	.006 x Dia
13 to 25	.006	.008 x Dia	.006 x Dia
Over 25	.006	.200 total	.150 total

TABLE II: 4-CYCLE DIESEL, GAS ENGINES

Diesels—Uncooled Pistons

Diameter, in.	Minimum side clearance, in. Compression 2 top	Compression Others	Oil	Min. end clearance for step & straight cut joints, in.
Below 6	.004-.005	.003-.004	.002	.006 x Dia
6 to 12 15/16	.006-.008	.004-.006	.003	.006 x Dia
Over 12 15/16	.008-.010	.006-.008	.004	.006 x Dia

Diesels—Cooled Pistons

Below 6	.003-.004	.002-.003	.0015-.002	.005 x Dia
6 to 12 15/16	.005-.007	.003-.005		.005 x Dia
Over 12 15/16	.007-.009	.005-.007		.005 x Dia

Gas Engines—Uncooled Pistons

Below 6	.006	.005	.003	.006 x Dia
6 to 12 15/16	.008	.006	.004	.006 x Dia
Over 12 15/16	.010	.008	.005	.006 x Dia

Gas Engines—Cooled Pistons

Below 6	.005	.004	.0025	.005 x Dia
6 to 12 15/16	.007	.005	.0035	.005 x Dia
Over 12 15/16	.009	.007	.0045	.005 x Dia

TABLE III: 2-CYCLE DIESEL, GAS ENGINES

Diesels—Uncooled Pistons

Diameter, in.	Minimum side clearance, in. Compression 2 top	Compression Others	Oil	Min. end clearance for step & straight cut joints, in.
Below 6	.006-.008	.004-.006	.003	.008 x Dia
6 to 12 15/16	.010-.012	.008-.010	.005	.008 x Dia
Over 12 15/16	.012-.014	.010-.012	.006	.008 x Dia

Diesels—Cooled Pistons

Below 6	.005-.006	.003-.004	.0025	.006 x Dia
6 to 12 15/16	.009-.010	.007-.008	.0045	.006 x Dia
Over 12 15/16	.011-.012	.009-.010	.0055	.006 x Dia

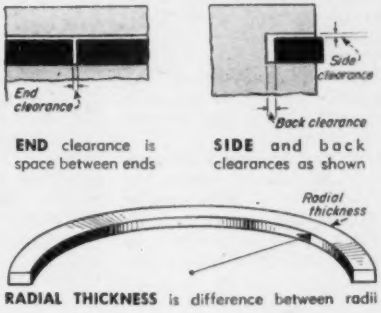
Gas Engines—Uncooled Pistons

Below 6	.008	.005	.004	.008 x Dia
6 to 12 15/16	.012	.010	.006	.008 x Dia
Over 12 15/16	.014	.012	.007	.008 x Dia

Gas Engines—Cooled Pistons

Below 6	.007	.005	.0035	.006 x Dia
6 to 12 15/16	.011	.009	.0055	.006 x Dia
Over 12 15/16	.013	.011	.0065	.006 x Dia

If angle joints in Tables II, III, multiply end clearances by 0.7



END clearance is space between ends

SIDE and back clearances as shown

RADIAL THICKNESS is difference between radii

SUGGESTED MAXIMUM RADIAL THICKNESS

Diameter	Thickness	Diameter	Thickness	Diameter	Thickness
6 to 6¼	.247	9½ to 10	.365	18 to 19	.615
6¼ to 6½	.255	10 to 10½	.380	19 to 20	.645
6½ to 6¾	.259	10½ to 11	.395	20 to 21	.670
6¾ to 7	.271	11 to 11½	.410	21 to 22	.700
7 to 7⅛	.275	11½ to 12	.425	22 to 23	.725
7⅛ to 7⅓	.288	12 to 13	.450	23 to 24	.755
7⅓ to 7¾	.296	13 to 14	.480	24 to 25	.780
7¾ to 8	.305	14 to 15	.505	25 to 26	.810
8 to 8½	.320	15 to 16	.535	26 to 27	.835
8½ to 9	.335	16 to 17	.560	27 to 28	.865
9 to 9½	.350	17 to 18	.590	28 to 29	.890

Tips on Clearances and Ring Dimensions

Engine and ring manufacturers have pet theories about ring dimensions and clearances. They don't always see eye to eye, but here's general practice followed.

End Clearance keeps high internal temperature from expanding ring to butt, then binding against cylinder. Idea is to have smallest possible opening and yet not enough to let working piston bind.

Amount of end clearance depends on temperature and type of service. But each ring's temperature varies on same piston. So top ring of diesel piston is hotter and expands more than bottom ring.

One ring manufacturer supplies diesel rings with 0.005-in. end clearance for each in. of cylinder diameter. A 10-in. ring would then have 0.050-in. total end clearance. Same firm supplies rings for pumps and compressors with 0.003-in. clearance per in. of diameter. So a 10-in. ring would have a 0.030-in. total end clearance.

If sealing-type joint ring seals well, end clearance is not important so long as ring does not butt. Enough clearance is given so there is no chance of ring ends butting.

One engine manufacturer specifies ring end clearance of 0.008 in. per in. of cylinder diameter, while another specifies 0.005 for a similar engine.

If you must make your own rings, or if you file manufactured rings for end clearance, use data in tables given here.

Side Clearance. Because ring moves in and out against uneven cylinder as piston travels, it must be free. In cylinders handling clean gases, such as steam or air, side clearance is much less. But in internal-combustion engines that burn

fuels, which leave deposits, there is trouble if side clearance is not right. Carbon deposits in grooves prevent rings sealing combustion. When rings stick at smallest cylinder diameter, they are no better than a solid plug.

If all rings have too little clearance, second ring sticks shortly after top one. Reason is that top ring lets hot gas by after it sticks. Before long, all rings will stick tightly.

One important function of side clearance is to let cylinder pressure flow behind ring to force it against cylinder wall. Without this pressure on ring's back, ring's tension is not enough to hold ring against cylinder for proper sealing.

Clearance Needed. One engine builder suggests a side clearance of 0.004 to 0.012 in., depending on ring's width and type of engine. Another engine maker recommends as much as 0.012 in. for a 0.5-in.-wide ring. On 4-cycle engines rings run cooler, side clearance is usually less than 2-cycle. Tables given here cover various kinds of machinery.

Position of ring on piston is also important. Here are one engine maker's recommendations for a 4-cycle supercharged diesel, having 10½-in. bore: Top-ring side clearance is 0.006 to 0.007 in. Ring in second piston groove 0.005 in. Next two rings down 0.003 in., and bottom ring only 0.002 in. clearance. That shows how higher temperature at piston's top affects top rings.

Back Clearance. Space in back of ring is least important. But make it more than enough to keep ring from touching the piston. Yet, if groove is too deep, piston ring land is weakened, may even break during heavy load. If it's too little, carbon buildup may prevent ring floating.

But back clearance can cause a major problem if side clearance is too small. In that case there is a wire-drawing effect between top side of ring and groove. This is caused by gas loading and unloading through narrow side clearance to larger space in back of ring with each stroke.

A standard back clearance is 0.003 in. per in. of ring diameter. That would make total clearance of a 10-in.-diameter ring 0.030 in.

Radial Thickness. Piston rings must be flexible enough to conform to slightly oval cylinder walls. To do that, rings must have all dimensions of right proportion.

Because most piston rings are expanded over piston when installing or removing rings, radial thickness must not be enough to distort or break ring. A "heavy" ring strains diametrically opposite the ring joint when expanding over piston. Heavy rings either deform or break. The greater the radial thickness, the more ring must be forced open to fit over piston. For heavy one-piece rings, use built-up type piston, so ring is placed directly into groove and follower plate is clamped over ring.

One reliable formula for rings up to 15-in. diameter is to make radial or wall thickness about 0.035 in. times cylinder diameter. This makes a 10-in. diameter ring 0.350 in. wide across the wall. Above 15-in. diameter, rings are made 0.028 in. times diameter.

Some manufacturers go as low as 0.028 in. times diameter for rings under 15-in. diameter; slightly less for rings over that size.

Table of *Radial Thickness* on p 125 shows SAE standard up to 8-in. dia. Dimensions shown above 8-in. dia are recommended to ASME by ring firms.

When Ordering Rings...

Use this quick trouble-shooters chart...then send ring manufacturer this information:

Condition	Suggested improvement
Blowby	(1) Sealing-type rings (2) multiple-piece rings (3) tapered-face rings
Bad ring or cylinder wear	(1) Chromium-plated rings—or chromium-plated cylinder (2) combination bronze and cast-iron rings (3) tin or chemical-filled rings
Ring scuffing	(1) Surface-treated rings (2) coated rings (3) bronze sealing-type rings
High oil consumption	(1) More drastic oil-control rings (2) ventilated inner (expander) ring (3) drill more holes for drainage and follow piston grooving suggestions given
Stuck rings	(1) Larger side clearance (2) wedge-shaped rings (3) sealing-type rings
Broken rings	(1) Larger end clearance (2) larger side clearance (3) doweled rings if 2-cycle engine
Port chipping	(1) Chamfered joint rings (2) doweled rings (3) double-locking rings

Information for manufacturer

1. Type of rings that are needed
2. Number of rings that are needed
3. Cylinder size at smallest diameter
4. Width of each ring groove
5. Depth of ring grooves
6. Dowel diameter (if rings are to be notched for dowels)
7. Make of machine that rings will be installed in
8. Horsepower or size of machine
9. Engine's revolutions per minute
10. If diesel, whether 2- or 4-cycle
11. Number of cylinders
12. Number of piston rings above wrist pin
13. Number of piston rings below wrist pin
14. Are rings for newly rebored cylinders?
15. If oil rings for drilled oil-return holes, are holes in or below groove?
16. Number of drilled grooves on piston
17. If machine has ring problem, give brief details of trouble, such as: (a) Top ring sticks. (b) Engine uses more oil than with last batch of rings (state type rings used before and type using now). (c) Rings above wrist pin keep breaking at ends, etc.

Acknowledgments

In preparing this manual, published literature was freely consulted; in addition, for liberal use of technical data, POWER is indebted to the following manufacturers: American Leather Belting Assn; Anchor Packing Co; Belmont Packing & Rubber Co; A W Chesterton Co; Condenser Service & Engineering Co, Inc; Crane Packing Company; Darcoid Company; Darling Valve & Mfg Co; Double Seal Ring Company; France Packing Co; Garlock Packing Co; Gatke Corp; L H Gilmer Co; Greene, Tweed & Co; Hollow Center Packing Co; Robt Holmes & Bros; E F Houghton & Co; Hunt-Spiller Mfg Co; Johns-Manville; Johnson Mfg Co; Koppers Co, Inc; Marlo Co, Inc; McQuay-Norris Mfg Co; Murray Iron Works Co; National Carbon Co; Perfect Circle Co; Pilot Packing Co; Raybestos-Manhattan Inc; J E Rhoads & Son; Safety Seal Piston Ring Co; Sealed Power Corp; Sims Pump Valve Co; Union Asbestos & Rubber Co; The United States Graphite Co; United States Rubber Company; Van der Horst Corporation of America; Wilkening Mfg Company.

POWER also thanks the following authors: *Wear*, by F P Bundy, T E Egan, R L Boyer; *Late Trends in Piston Rings*, by H G Braendel (paper presented at Metropolitan Section of Society of Automotive Engineers.)

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

More on the Bonehead Family

I SAT IN MY FAVORITE corner the other night about 11 o'clock having a night cap and dreaming of a boiler room completely outfitted by me . . . on a commission basis. Right in the middle of the final sale, I snapped out of it when a safety valve in a dark factory boiler room nearby popped and continued to blow. The noise finally stopped, only to bust up my dreaming by a repeat performance a few minutes later. So I joined the cop to locate the engineer.

He finally arrived and introduced himself as Jeremiah Bonehead. We all went in and found the water out of the glass from continued blowing of the safety valve. Then we learned that Jeremiah had shut off the oil burners at 4:55 pm with 100-lb pressure on the boiler. He waited for five minutes, closed the stop valve and went home.

I explained patiently to him how to take a boiler off the line. Keep the water level high, and work the pressure down to about one fourth of the safety-valve setting before closing the stop valves. Next day I went back and got an order for handhole and manhole gaskets plus some "DON'T TOUCH" tags for blowdown, stop, and feed valves. I told Jeremiah that it was also good practice to tag empty furnace doors. His cousin, Willy Bonehead, had just placed a large order for tags reading: "EMPTY BOILER, DO NOT FIRE!" It would have been cheaper had he bought them before the janitor used the empty boiler for trash!

STEVE SMITH *Canton, Mass.*

Hot Tip on Oil Hazard

In Refrigeration Q & A (p 116, April POWER), Mr Welsh should have qualified his statement on question 11 to cover the presence of oil in the refrigeration system.

If oil is present in an ammonia pipe, receiver, condenser or any other part of the system proper, there is just as much danger in cutting into it with an oxy-acetylene torch as there is in using a torch on any container used entirely for oil. This is true regardless of whether the system is open to atmosphere and ventilated.

If oil is found on inner surfaces, it should all be removed before flame is applied. There are some nonflammable chemical solvents on the market that will remove or neutralize the oil. Such removal before flame cutting cannot be too strongly emphasized.

O L BRAGE *Seattle, Wash.*

Regulitis? . . . Bah!

IN REPLY TO the article: Are You Guilty of Regulitis? (p 134 May POWER) all I can say is *Bah!* I run a small diesel power plant for a factory that has constantly changing load conditions, and I change the regulator settings at least once a week. I also change governor settings in between about twice a week. Anything less than this and I'd never keep up with load changes.

Maybe this isn't the best practice in the world, but it isn't so bad either. Despite what the article says, I've never caused wasted time, had erratic operation or power outages . . . and I've been doing it for a good many years. I bet a lot of other guys are in the same boat and are none the worse for it.

P SUNDWELL *St. Louis, Mo.*

What about it? How does the Regulitis question look to you? Send your views and we'll air them.—ED.

There Oughta Be a Law

REFERRING TO Marmaduke's story (p 144, April POWER), all I can say is that such a situation is ridiculous. Do you mean to say that the U.S. government allows unlicensed men to operate power plants?

In Canada each province has a chief inspector. Exams are set for aspiring engineers starting at 4th class and going up to 1st. By the time you pass your exams, plus the time and experience required, there is no doubt of your ability to operate a plant safely and economically.

If an unlicensed man were put in charge of a plant such as Marmaduke describes, the Chief Inspector would have the power to shut down the plant at once until unlicensed man is removed.

H C DIXON *Vancouver, B. C.*

This story happened just as Marmaduke told it, and up in Canada. There are two provinces in Canada that have no license requirements. But we admit that existing Canadian requirements make American ones look sick.—ED.

Wrong-Way Doors?

THE MAY ARGUMENTS (p 148) had a couple of safety items and a footnote saying: "We've not forgotten it." And speaking of safety reminds me of this:

A new factory had just gone up and I noticed that all the doors on the street level opened outward. Being nosey, I asked the contractor why most buildings had their doors open out while private homes usually have them open inward. He told me it was the law for public buildings so doors could be pushed out by rushing people in case of fire.

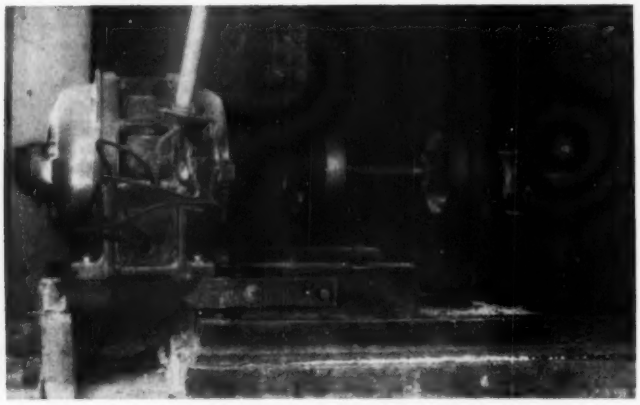
Well maybe the law is right, but I still remember working the 4-12 shift one cold wintry night. There was a blizzard raging outside, and my relief arrived late. When he got there, snow and ice had blocked the door so he couldn't get in.

I climbed a ladder and threw a shovel to him from one of the windows, and the poor guy worked out there for half an hour before he got the door open. On top of that, his relief the next morning worked twice as hard to get in.

I've cursed my own storm doors more than once for the same reason. Maybe someone can figure out a workable 2-directional door to satisfy the law and the seasons.

A CANNON *Laurence Harbor, N. J.*

PRACTICAL IDEAS...*here's the trading post for your*



Emergency Drive for Centrifugal Pump

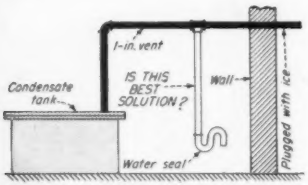
A WATER HOSE carelessly used knocked out our 50-hp motor driving a brine feed and distribution pump. There was no exact duplicate motor on hand to continue normal plant operations. We did have the right size and speed motor, but it was an older frame motor. Height from base to shaft center was 1½ in. too high.

Problem was to get this older motor hooked up in shortest possible time. There were many suggestions, but all proved costly and time-consuming. Photo shows how we hooked up motor until original unit could be rewound and returned.

We bored a pair of pin-and-bushing-type shaft couplings to fit a floating shaft. We always carry these finished couplings for emergencies. The other pair was used from original drive as pump half of coupling did not have to be removed from pump. And the motor half fit the old motor shaft perfectly.

While millwrights assembled simple base, our machine shop did the machine work. Electricians were removing burned-out motor and moving spare motor to new location. Assembled unit ran very smoothly although exact shaft alignment was not absolutely necessary. With 750 motors and drives, we won't forget this hookup if we need it again.

U J GRANT *Rittman, Ohio*

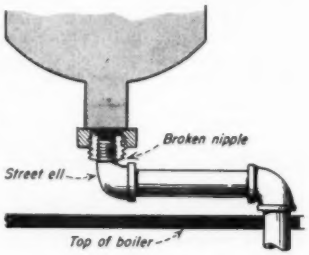


Is Gooseneck Best?

A VENTED CONDENSATE-return tank ruptured violently. We found the outside portions of the 1-in. vent line plugged solid with ice. Freezing of condensation and vapors caused this accident. Possible leaky steam traps built excessive pressure and caused tank to pull apart at the welded seams.

To prevent another accident, I ran vent to floor inside of wall where it won't freeze. Gooseneck on end seals vent with water, sketch. Can POWER readers offer a better suggestion? Present hookup is an emergency measure, but I'll keep it until I learn of a better one.

A WALTER *Clifton, N. J.*



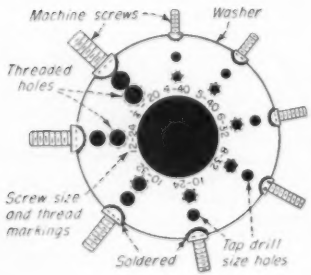
Emergency Pipe Jobs

A ¾-IN. NIPPLE on the drain pipe of a 2-in. steam separator started to leak. It was rusted through so badly that the nipple twisted off when I tried to remove it. There was not time to shut down the plant to disconnect separator from steam line. Also, there wasn't enough space between separator and top of boiler, sketch.

I made a quick temporary repair. First, I tapped the inside of broken nipple in separator connection with a ½-in. pipe tap. Then I used a ¾x½-in. street ell. This made connection to the old ¾-in. drain pipe, as shown.

H A JAHNKE *Milwaukee, Wis.*

Screw and Nut Gage Saves Time

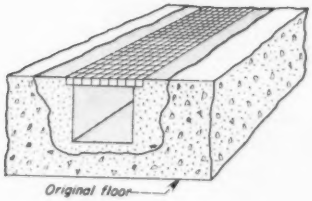


A CONVENIENT GAGE for checking sizes of machine screws and nuts can be made as shown. Drill a large washer with two sets of tap drill-size holes. Tap one set afterward. Size is then marked opposite each tapped hole. Solder or braze a set of machine screws to the washer's rim. Widen screw slots with a file to fit the washer's rim thickness. Use set of holes opposite threaded holes as a tap drill-size gage. Here's three gages in one.

T TRAIL *Catonsville, Md.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

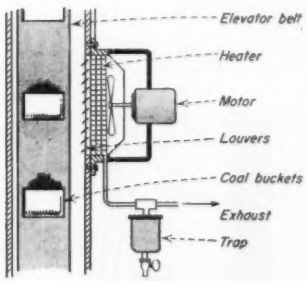


Floor Drain

WHEN EVERY EFFORT to open the tile, leading from several of our basement floor drains to the sump, failed, we built a ditch (sketch) and covered it with ¾-in.-thick open steel grating.

A trench was dug with air hammers to an average depth of about 8 in. and width of about 16 in. Then we built forms and poured concrete, leaving an 8-in.-inside width and a depth of 7 in. at the deep end. A ¾-in. ledge runs along the top edges to support the flooring on a level with the floor. We find this better than the original floor drains.

R KIMMET *Genoa, Wis.*

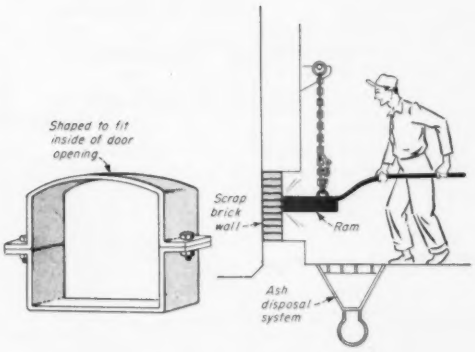


No More Frozen Coal

DURING COLD WEATHER we used to have a lot of trouble with wet coal freezing in the elevator buckets. This caused plenty of delay in filling the bunkers, as the elevator had to be stopped quite often, and the buckets cleaned.

This fall we installed a heater unit as in sketch. Results were so satisfactory that a similar unit is now being set up higher on the elevator casing. Coils for steam, steam-trap and electric fan did the trick. Fan blows enough heated air across the slowly moving vertical belt to thaw out the coal. A few pounds of heating steam will do.

JOHN FARINA *Princeton, B. C.*



Knocking in Ash Doors Easily

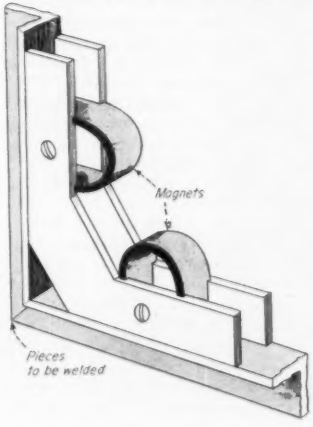
WE HAVE three 75,000-lb-per-hr boilers operating at 600 psi. They burn hog fuel and mill waste. Each boiler is fitted with a 3-cell, grateless dutch oven, which can easily run three weeks without cleaning a fire. We shut down one boiler each week end in turn.

To protect ash doors during a run, we bricked up the opening flush with inside of wall, using scrap brick. Although bricks were set as loosely as possible, slag and clinker fused them into a solid mass on inside. That made them very hard to pry out. We made a ram, sketch, to break bricks through into the furnace. Ram did this with one-tenth the time and effort, and with fewer broken bricks than did previous method of barring them out.

Our next step was to make a form. This was filled level with mixture of cement and clinkers and used in place of bricks. Although these are destroyed each time the fire is cleaned, they are less trouble and cheaper all around than brick. Now ash-door is no problem.

E A SMITH *New Westminster, B. C.*

We Made Magnetic Welding Locator



WE BUILD UP many small structures by welding together light rolled-steel section pieces. They must be fairly accurate, especially right-angle corners where two separate pieces are welded together. To hold two pieces together at right angles, both on bench and on partly assembled structures, we made magnetic welding locator, sketch.

This does job without using mechanical clamps. Basis of locator is two powerful U-shaped permanent magnets, from old magnetos of industrial engines. Magnets are powerful and accurate for size.

Frame to hold magnets is two cheek-plates cut from aluminum alloy plates. Shallow grooves, milled on inside faces, mate with magnet's legs. Aluminum al-

Begins on page 128

loy was chosen for cheek plates because of its nonmagnet properties and light weight. Cheek plates are held together with brass screws as shown.

Corner of cheek plates at right-angle edges is cut away to leave space to apply welding electrode to inside corner for tack welds.

When joint in work has been welded, magnetic locator is removed by sliding it off the work. It's almost impossible to remove the locator by pulling clear.

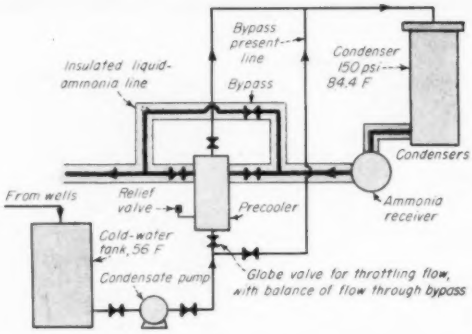
F E Riley *London, Eng.*

Check Coal-Delivery Pipe

I once had trouble keeping steam pressure, even with stoker set at highest speed. In checking, I found the feed screw was not delivering enough coal into the retort. Cause was badly worn screw. I replaced it with a new screw, but still there was trouble keeping up steam pressure. In checking, I saw that coal-delivery pipe was badly worn on inside. I had failed to examine pipe when replacing the screw.

A new delivery pipe cleared up this trouble. The old one was so badly worn the feed screw would bypass the coal. After this experience, when installing a new feed screw, I also install a new coal-delivery pipe, especially if pipe has been in use for a very long time.

H A Jahnke *Milwaukee, Wis.*



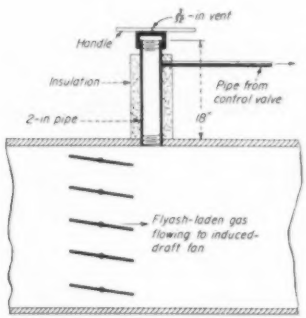
Precooling Liquid Ammonia

Where water for condensing ammonia is 60 F or under, it's economical to run water in series through a heat exchanger, then to ammonia condensers, sketch.

Here's how it is hooked up in our plant: ammonia at 150 psi condenses at 84.4 F. With 56-F water, it's economical to precool to 61 F. We have 800-ton load. At .42-lbs ammonia per minute per ton, heat removed is 9080 Btu per min; at 200 Btu per min per ton, it's 45.4 tons. This represents 5.6% increase in refrigeration capacity, or a decrease of 97.5 hp at 1.7 hp per ton for this capacity plant.

Investment will be amortized within a year for the above example. If liquid lines are long and are routed through rooms at 75 F and above, they should be insulated as shown here.

M Evans *Chicago, Ill.*



No More Plugged Control Piping

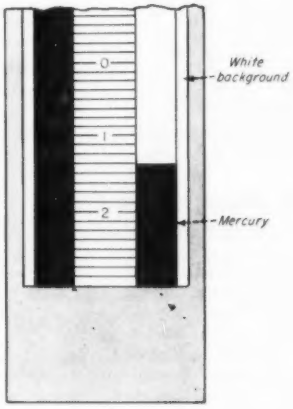
We have a semi-outdoor boiler installation with an induced-draft fan speed control. Fan speed is varied by a hydraulic coupling, working with a controller to give a 2-in. water pressure drop across a damper at the inlet to the i-d fan. This damper is in turn actuated through another control to keep the furnace at a minus 0.2-in. pressure.

We had trouble with flyash plugging the ¾-in. pipe to control diaphragm on damper upstream and downstream. Plugging was caused by boiler gases entering ¾-in. line on pressure changes. Being outdoors, gas cooled below dew-point and condensation formed. Then flyash stuck, resulting in a cement-like formation plugging connections.

Connections had to be rodded out frequently. Besides, plugged control lines gave us sluggish fan operation, also hunting boiler-control.

To correct, I increased size of connections at source, from ¾-in. to 2-in. pipe, sketch. I also drilled a 3/32-in. hole in each cap at connections. Hole keeps air flowing into pipe and keeps it clear of flyash. The 2-in. connection is large enough so this small 3/32-in. hole does not affect control. Since drilling the holes, there's been no plugging in connections. Boiler control has also improved so it works smoothly.

C J Werderitch *Clinton, Iowa*



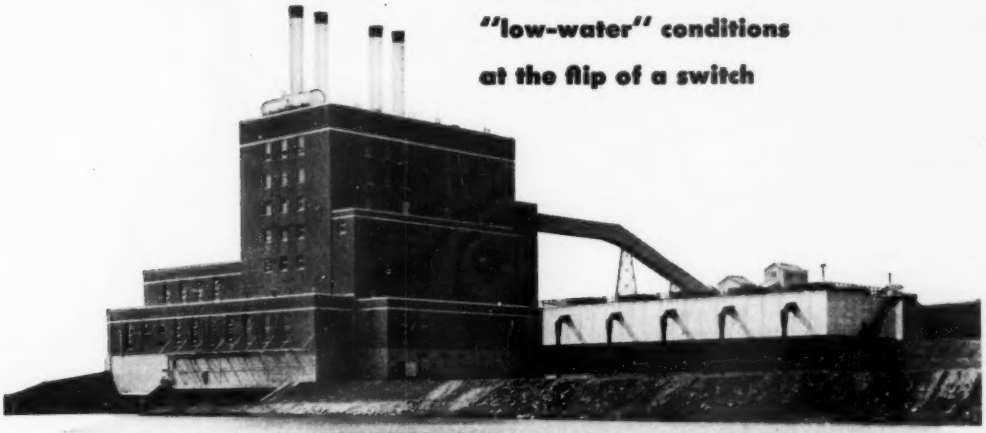
U-Tube Gage

U-Tube gages can be made easy to read. First remove the glass U-tube from gage. Then paint rear half of outside

(*Continued on page 132*)

a standby for nature

—ready to meet
"low-water" conditions
at the flip of a switch



This new, ten-cell Foster Wheeler cooling tower was installed by a major southern power company for the sole purpose of meeting their cooling needs when the water level of the river drops too low.

Sheathed with fire-proof asbestos board, this installation cools 50,000 gallons per minute from 114° to 91° F with a spray and evaporation loss of less than 2.5%.

For power generation, oil refining or chemical production—year-round or intermittent operation—there's a Foster Wheeler cooling tower to meet your particular requirements. Each tower is engineered and constructed to give you maximum performance at minimum cost.

Get the whole story...

Send for this new, well-illustrated catalog today. Includes helpful information on tower design for freezing climates, effects of recirculation and surroundings on performance, in addition to complete description of sound construction and high-quality materials to which Foster Wheeler customers have long been accustomed.

A data sheet is bound into the catalog to aid you in writing the specifications for the cooling tower which will best meet your needs. Write for Catalog CT-52-4 to:

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

Begins on page 128

surface with white enamel, as shown. Liquid column will be easy to read, especially where mercury is used.

When painting the U-tube, place scotch or masking tape on front half. Remove tape after enamel is dry. This keeps the front neat, lines straight.

T TRAIL *Catonsville, Md.*

'What Stopped All Our Pumps?'

IN OUR WATERWORKS SYSTEM we have three vertical motors on turbine pumps in a pump house built over a storage reservoir. On a cold day last month all pumps stopped. We had no water.

Investigation showed that all thermal overload relays had operated. This was a puzzle until the pumper said he turned the gas heaters on full because it was cold and he wanted nothing to freeze.

Later when the weather was warmer, the pump house got so hot that the relays operated. We have not had this trouble since then. Now we keep the gas down and the inside temperature of pump house at a reasonable figure.

E A ROBERTS *Hobbs, N. M.*

Nice Hobby for Engineers

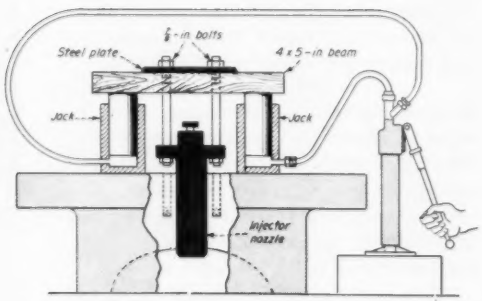
THIS LITTLE STEAM ENGINE actually runs. Earl Andersen of Salem, Ore. has built five of these babies as a hobby. The cylinder is a .22-caliber shell pressed into a steel block. Engine stands 1½ in. high and weighs 1½ oz. When running it sounds like a large fly. What's it mounted on? You guessed it—a dime. At present, no tests have been run to determine engine's horsepower rating.

Handy Valve Lock

AT TIMES you have to lock valves. But they are not usually equipp d for this purpose. Here's what I do:

Get an ordinary can large enough to cover valve body and depth to take valve at open piston, sketch. Cut slots in can to slip snugly over pipe. Next place eyebolts near bottom. Attach short pieces of chain to eyebolts to reach across can. Place can over valve, pull chain into place and lock.

D J PARMER *Quincy, Fla.*



Injection Nozzle Remover

WE TRIED all the tricks we could think of, but the diesel injector would not move. So we tried two hydraulic tie rod jacks that came with the engines. Reason these jacks work so well is that an even pressure can be applied to both sides of I-beam. That allows nozzle to come up straight and not bind on the sides of the chamber in cylinder head.

I don't believe the nozzle could have been removed without this jack.

We applied about 14-ton pressure on each side of I-beam to get injector out.

C GILLESPIE *Ellendale, N. D.*

The Empire District Electric Company orders and reorders...

IN MISSOURI— YARWAY

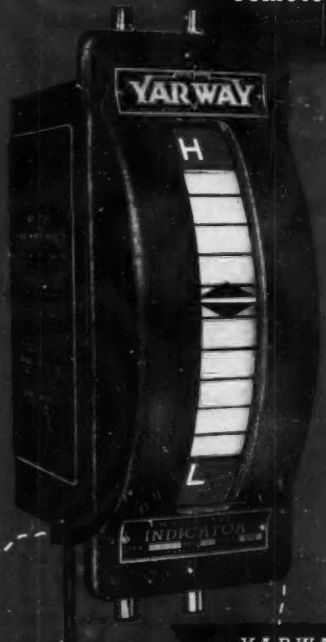
ANSAS

ILLINO

Seven Yarway Remote Liquid Level Indicators on instrument panel at Riverton plant of The Empire District Electric Company. Each is equipped with control unit and remote Hi-Lo Alarms.

YARWAY

remote liquid level indicators



In Missouri (so the saying goes) you've got to show them your product is good.

Apparently The Empire District Electric Company at Joplin was shown. Not only are they satisfied with 7 Yarway Remote Liquid Level Indicators at the Riverton plant, but also plan to use 3 others in a new installation.

Yarway Remote Liquid Level Indicators [illegible] convenient eye level. Accuracy is assured because the indicator is operated by the liquid itself — by the pressure differential between a constant head and the varying head in the drum or tank. Indicating mechanism is never under pressure. There are no stuffing boxes.

New control unit permits operation of additional Hi-Lo Alarms (light or horn) at any remote locations.

See Yarway Indicator Bulletin No. WG-1633 or Bulletin No. WG-1830 for the Yarway Indicator-Recorder.

MISS

YARWAY SERVICE GOES ALL THE WAY...

EXAS

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PLANT PROBLEMS . . . *put your know-how to work*

Why Does Oil-Burner Pressure Fall Off?

HERE ARE THE FACTS: We burn No. 6 oil in a 3500-lb-per-hr A-type watertube boiler. Burners are mechanical-atomizing type. Load varies a great deal during the day.

Recently we've been bothered by excessive smoke coming from our stack. Burners are hand controlled and we have some trouble keeping the fires and load balanced.

Oil-return line at boiler is fitted with a ½-in. pop valve. Similar pop valves are on oil-pump discharge. All these valves relieve excess pressure in burner supply line.

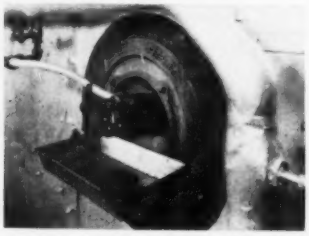
When oil is hot it appears to heat valve spring, changing the tension and allowing return-line valve to open at too low a pressure. So pressure in burner line varies.

Is this variation the cause of smoke? Can heat from oil change spring tension? What's best and simplest way of stopping smoke in our plant?—*HP*, April *Power*

Here Are the Answers

NEAT INSTALLATION has oil meter, pressure gage and thermometer grouped for easy reading by boiler operator. With right layout, you get better firing, less smoke

REMOVE burners for cleaning at regular intervals. Then combustion is better



CATCH oil drips in metal pan mounted below the burner. Keep the pan clean

GOOD PRACTICE in burner installations is shown in photos. Oil meter, pressure gage, thermometer and return line to tank are essential for efficient, smoke-free combustion. Keep your burners clean at all times.

IRA C KANE *New York, N. Y.*

DIRTY RELIEF VALVES may stick shut, allowing oil pressure to rise without a proportionate increase in air supply. This gives excess smoke. Take all relief valves apart and clean thoroughly. Put back in line and check system operation.

Oil temperature doesn't change pop-valve spring tension. Oil viscosity is lower at higher temperatures.

Fit oil heater with thermostat to maintain a fixed oil temperature at burner. Consult burner manufacturer for right temperature. Adjust burner relief valve to give right pressure after oil is up to temperature. If burner still smokes, adjust primary and secondary air supply for good combustion.

GEORGE H HILL *Sunbury, Pa.*

LOOK FOR dirty oil strainer, sludge in oil tank or gate valve in suction line partly closed. If there's not enough oil reaching pump, pressure will be low. Check your boiler room to see that there are enough fresh-air openings to permit easy, steady flow to boiler furnace.

AL KELLING *Parma, Ohio*

SET POP VALVE at fuel-oil pump to open at a pressure less than that of pop valve beyond burner. Then cold oil will be returned to tank during periods of high pressure in the system. Setting like this stabilizes pressure, gives good atomization without smoke.

A RODRIGUEZ ULLOA *Polanco, Mex.*

SMALL PUMP, worn relief valve, or lines that aren't right size for job can cause low oil pressure. Too much oil at low loads, or wrong oil pressure or temperature can cause smoke. Steam-atomizing burners are better for *HP's* load.

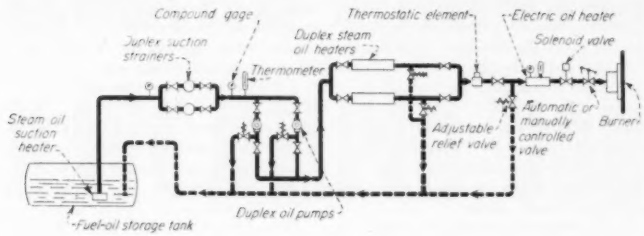
MELVIN EVANS *Chicago, Ill.*

LIGHT LOADS, when burners are turned down, cause pressure and temperature build-up. Pop valves relieve excess pressure. *HP* will get good results if his pop valves are set to open 25% above needed burner pressure. Lower setting causes pop valve to open too often.

A BELTON *Montreal, Can.*

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*



HAND CONTROL of burners causes smoke. Even when boiler has a fixed load you need close supervision of hand control to prevent smoke.

Sketch shows typical piping for rotary-cup-type burners for small water-tube boilers. Solenoid valve just ahead of burner is interconnected with safety switches that shut off burner when flame fails or water level is too low.

HP's best solution is automatic combustion-control equipment. Oil temperature does not cause pop valve to open at lower pressures. Spring may be set too low for his system.

G F CONNELL *Detroit, Mich.*

WE USE a hand-operated valve in return line from burner. When we cut fires we crack this valve just enough to maintain needed pressure in burner header. We have pressure gages ahead of and after our fuel-oil heaters and strainers. With these it's easy to make a quick check on heater or strainer cleanliness.

Be sure to keep the same size tips in all burners of a boiler. Then you know how cutting out one or more burners affects capacity. Run with burner valves wide open and control firing with pump governor or by cutting out a fire as needed.

K W LUMAN *Parkersburg, W. Va.*

DIRTY OIL HEATERS or faulty thermostatic controls can give plenty of smoke trouble. Renew burner tips when they show signs of wear. Worn and pitted slots make clean, efficient burning of oil difficult.

HP will get better combustion if he seals all leaks in boiler setting. He'll then have complete control of air entering furnace. Keep fans clean (if used). Check to see that gas flow through furnace passes and breeching isn't obstructed. Be sure baffles are in good condition.

Regulate pressure of steam-driven pump with a governor, using relief valve only for safety. *HP* may find that steam-atomizing burners are better for his load conditions.

A CANNON *Laurence Harbor, N. J.*

VISCOSITY CHANGE causes fall in oil pressure. There is large fall in No. 6 oil viscosity when the oil is heated. With constant-volume-type pump more pressure is needed to move cold oil than hot thin oil.

HP's relief valve won't keep line pressure at valve popping point under all loads. When oil is viscous and a large quantity is passing through valve, line pressure will be greater than popping pressure because there's a pressure loss through valve.

Install a temperature regulator on oil heater. Set at temperature recommended by burner manufacturer. With oil at right temperature adjust relief valves to keep line pressure at needed value. Mechanical burners, run below design pressure, don't atomize correctly and smoke results.

ARTHUR HOLT *Miami, Fla.*

SMOKE DETECTOR using a photoelectric cell in stack to control stack damper will stop smoke. It takes care of small load changes. Burners will still have to be adjusted by hand when there's a large change of load. To prevent getting in trouble with local smoke authorities a smoke alarm is an excellent investment.

Try replacing relief-valve springs with new ones. Be sure they are the right size and have correct rating for your valves.

F C BELSAK
Energy Control Corp, Philadelphia, Pa.

POP-VALVE TROUBLE is smoke cause. The fact that it opens shows system oil pressure is too high or valve setting too low. You can't exert good control over oil entering furnace when large quantities are bypassed to tank.

Be sure relief valves are designed for No. 6 oil, not for steam. See that valve pressure and temperature rating are high enough for the hot oil you're handling.

Stop smoke by heating oil to within 10 to 15 F of flash point. Temperature is important. At 230 F our No. 6 oil burns without smoke—at 225 F it smokes badly. Keep oil strainers clean. This prevents sediment from reaching and clogging relief-valve seats. Check with burner manufacturer to see that you're using right oil and temperature for the burner.

HP will find that low-priced automatic combustion controls for small boilers are really worthwhile. Air flow follows steam flow and fuel flow rate is automatically adjusted to follow air flow. There's less danger of excess air or excess fuel reaching furnace.

Heavy black smoke means furnace doesn't get enough air. Brown haze often means combustion is good. Dense white smoke means excess air.

L W FITZPATRICK
Jefferson City, Mo.

KEEP OIL PRESSURE between 150 and 250 psi, temperature between 185 and 225 F for usual No. 6 oil. Change fuel and air settings at same time when boiler load goes up or down.

L HAGGARD *Cincinnati, Ohio*

OIL-PRESSURE fluctuations change flame size, can cause smoke. Keep oil pressure as constant as possible. Here are points to watch in burner operation and maintenance:

(1) Replace worn tips as soon as you find them. (2) Knock off carbon buildups on burner tip before they spoil atomization.

(3) Make sure air flow is regulated at same time oil flow is on hand-controlled burners. (4) Don't overload burners. (5) Remove out-of-service burners from furnace. This stops nozzle carbonization.

(6) See that fuel-oil pump has a fairly constant discharge pressure. (7) Keep oil strainers clean.

R P MARCHE *Bloomfield, N. J.*

(*Continued on page* 136)

More PLANT PROBLEMS

Begins on page 134

WRONG BURNERS are used in *HP's* plant. With highly variable load steam-atomizing burners are better. They have wide capacity range without need for changing tip or gun assembly. Not as high oil temperature is needed and pressure range is only from 2 to 125 psi.

Pop-valve spring tension does change with temperature. But carbon-steel springs are good for temperatures to 400 F. Fuel-oil temperature seldom goes above 225 F. So *HP* can forget tension change.

Improper atomization and poor control of fuel supply cause smoke. Cut smoke with automatic controllers that regulate fuel and air delivered to boiler and keep furnace draft at right value. Master controller on outlet steam header would probably be best.

A J Breugelmans *New York, N. Y.*

COLD SETTING with heavy load is bound to smoke. Keep fire low until brickwork or setting becomes hot enough for proper combustion. Insufficient air and draft also cause smoke.

HP's trouble is common, especially if operator doesn't have a sharp eye. It looks to me as though his boiler smokes under heavy load when air flow hasn't been adjusted with oil flow. Or he gets smoke when lighting off a high fire after a temporary shutdown.

J R Hines *Goose Bay, Labrador*

Other readers who submitted good answers, which couldn't be published because there wasn't enough space, are:

E A McGrath *Chicago, Ill.*
C A Wilkes *Oaklyn, N. J.*
Fred Tronsen *Milwaukee, Wis.*

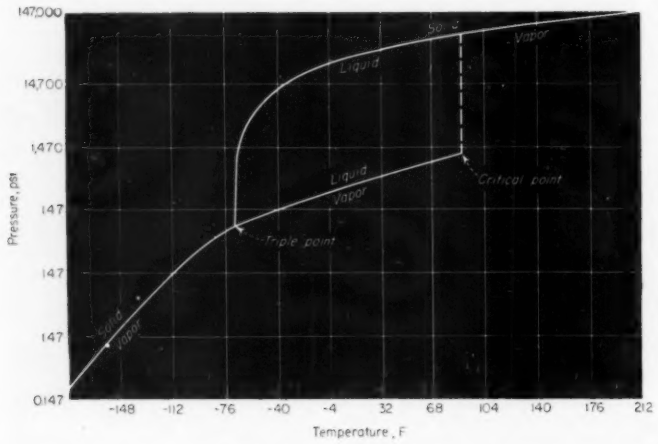
Why Does Our Pump Become Snowbound?

HERE ARE THE FACTS: We salvage chips of dry ice in our plant by liquefying them in a hot-water jacketed tank. Motor-driven pump takes suction from bottom of tank and discharges into a horizontal, insulated storage tank. See sketch, p 136, April *Power*

Carbon-dioxide vapor formed in storage tank vents to liquefier through overhead line. After we run pump about 5 min, suction line and cylinder become plugged with dry ice.

Why does dry ice form in suction? How can we prevent it? Can we run pump continuously without ice and vapor?—*TF*, April *Power*

Here Are the Answers



PHASE DIAGRAM for CO_2 will help *TF* understand his system better. As you can see, lowering the temperature below –69.9 F, the triple point, produces either a vapor or solid, depending on pressure in system. Between the triple and critical points we have a vapor, liquid or solid, depending on pressure. If *TF* connects pressure gages and thermometers to pump suction line at liquefier and pump, he can see what state he should have at these points. Also, he might find why ice forms.

K R Land *New York, N. Y.*

CENTRIFUGAL PUMP may be better for *TF's* system than the reciprocating unit he now uses. Properly selected centrifugal won't reduce suction pressure to point where liquid flashes into vapor. Real cause of trouble is drop in temperature and pressure of the CO_2. Any means *TF* uses to keep temperature and pressure up should help stop the frost.

C W Parks *Overlea, Md.*

MOVE PUMP closer to liquefier so pressure drop between tank and pump is less. Check pipe size; it may be too small. If it is, increase one or more sizes. Automatic start and stop of pump by liquid level in tank may also help stop snow formation in pump suction. Set control so there's always enough head on pump suction to prevent flashing in the pipe.

A J Breugelmans *New York, N. Y.*

POOR CIRCULATION of hot water in jacketed liquefier may not allow temperature of dry ice to rise high enough to cause melting. Hot water or steam jacket around pump suction may stop snow formation there. Also, since the hot water is cooled in liquefier, it might be better to feed water at top, drain it from the bottom. This will increase circulation in the jacket.

H W Congdon *Auburn, Mass.*

TROUBLE will go on as long as *TF* does not check his entire system for undersize pipes, lack of insulation or a heat source near suction line. If this problem is serious, he should have a consulting engineer make a complete analysis of the system.

T L Cooney *New York, N. Y.*

(*Continued on page* 138)

LEADING MANUFACTURERS HAVE HELPED "JOB PROVE" SUN TRANSFORMER OILS

Over the years, leading manufacturers of transformers have helped us "Job Prove" Sun Transformer Oils. They have found, through continuous use, that these Sun oils have the excellent heat-transfer characteristics needed to meet the requirements of today's transformers. In addition, they are highly stable and resistant to oxidation, completely dependable in protecting equipment and reducing maintenance and replacement.

Sun has had broad experience in the electrical industry. We have for many years specialized in formulating and supplying oils for cables, transformers and capacitors. Our knowledge of the industry's requirements, coupled with extensive research, development and refining facilities, enables us to offer products to satisfy the most rigid electrical requirements.

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Philadelphia 3, Pa.

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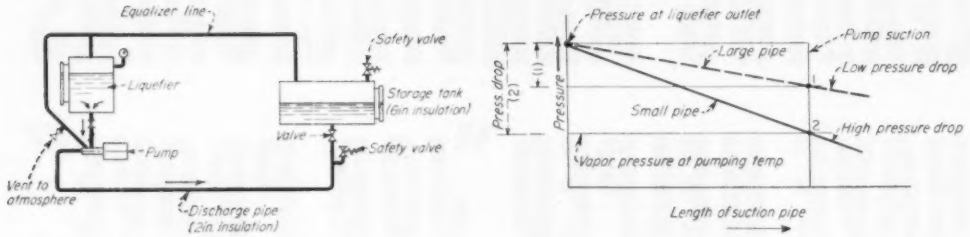
More PLANT PROBLEMS

Begins on page 134



FIVE STEPS for curing this problem are: (1) Make suction head as large as possible. (2) Keep suction-line friction losses as low as possible. (3) Insulate suction line. (4) Vent system. (5) Chill pump casing with ice if there is too much flashing.

Increase suction head by raising jacketed liquefier or lowering motor-driven pump. This reduces flashing of liquid in pump suction. Flashing binds pump and pipe, preventing flow into pump.

To prevent flashing, suction head must be great enough to overcome pipe friction losses, compensate for heat gains in the pipe and for vapor pressure of the liquid.

Run suction line from liquefier to pump in a straight line with as few fittings as possible. Keep line short and use a gate instead of a globe valve. To play safe, insulate suction line to prevent large heat pickup.

Run vapor equalizer to pump suction as shown in sketch above. Fit vent to atmosphere. Curves above show effect of friction loss in suction pipe. With high friction loss, pressure drop between liquefier and pump may be large enough to permit flashing in pump suction. Liberally-sized pipes with few fittings and bends reduce friction loss to the point where flashing is not possible under ordinary running conditions.

J D CONSTANCE
Cliffside Park, N. J.

SEPARATE DRY ICE from liquid by supporting ice on a fine screen. Then only liquid can be drawn into pump suction. Use a level control to maintain a fixed level in bottom of liquefier.

FRED TRONSEN *Milwaukee, Wis.*

RAISE LIQUEFIER so head of liquid on pump suction is greater. Or raise liquefier so it is higher than storage tank. Then liquid CO_2 will flow to tank by gravity, and there's no need for a pump.

G F CONNELL *Detroit, Mich.*

MELT CHIPS with steam instead of hot water. Steam will give faster melting and is easy to control. Snowbound line is caused by vapor instead of liquid passing through CO_2 system. Insulate all lines carefully.

L FITZPATRICK *Jefferson City, Mo.*

PRESSURE GAGES on liquefier and pump suction will permit *TF* to check loss between the units. If it is too large, increase pipe size. Strainer in pump suction line, close to or in liquefier, is also useful. It catches solid particles that may be carried by liquid.

J I LACEY *Niagara Falls, N. Y.*

PRESSURE LOSS at valve in liquid line or in pump valves may cause the trouble. Check valves for restrictions. Also look for scale or other obstructions in suction pipe that decrease its diameter. All these conditions can lead to flashing at pump suction.

O L BRACE *Seattle, Wash.*

VENT PUMP to liquefier ice compartment. Pressure in the two units will equalize, and head of liquid will produce flow to pump.

A RODRIGUEZ ULLOA *Polanco, Mex.*

Other readers who answered this question are as follows. Sorry there wasn't enough space to publish their letters:

A M PALMER *Brooklyn, N. Y.*
ARTHUR HOLT *Miami, Fla.*
MELVIN EVANS *Chicago, Ill.*

YOUR NEW PROBLEMS

1 How About Using Chemical Cleaning?

Scale in our watertube boilers and our heat exchangers gives us a flock of troubles. Friends of mine suggest using acid cleaning to cut work, cost.

I've never used acid to clean heat-transfer surfaces and I'd like to know how *Power* readers handle acid in their plants.

What acids are good for cleaning? Is heat generated by the reaction? What inhibitors are best for power-plant equipment?

Is there any danger to plant personnel when using acid cleaning? What's best procedure in cleaning boilers and heat exchangers? Are any testing devices needed? Will this method reduce number of men needed for scale removal?—*RP*

2 How Can You Spot Oily Condensate?

Our 3500-lb-per-hr boiler runs at 80 psi. It supplies steam to 15 coil-type heaters.

These heaters are submerged in lubricating oil, which we process in our plant. Each coil has a separate steam trap that discharges to a gravity-type return line.

Every now and then a coil springs a leak, allowing oil to enter. This oil returns with the condensate to boiler.

We've been wondering if *Power* readers have ever solved a problem like this. How can we detect oil in condensate from the coils? Is there any device that will separate this oil from the condensate? What we need are good piping hookups to cure this trouble.—*HF*

Will you help readers who sent us problems? Extra pay for photo or sketches.

FROM OUR FILE OF HEAT INSULATION JOBS

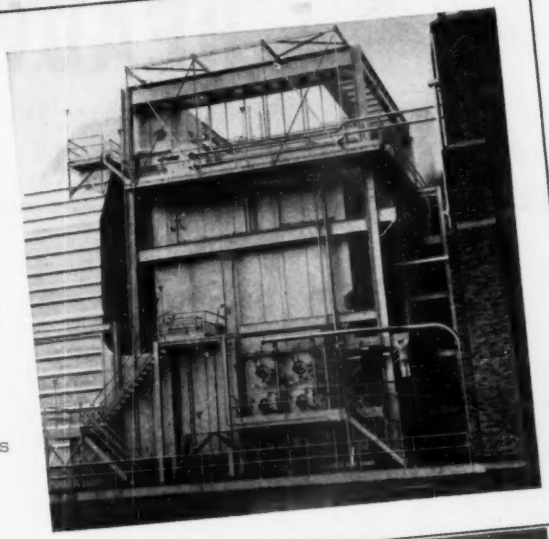
CONTRACT # 14839

COMPANY:
Public Service Company,
Weleetka Power Station,
Weleetka, Oklahoma.

INSTALLATION:
Babcock & Wilcox water wall boiler — gas, oil, or coal-fired — steam output=330,000 lbs./hr.

OPERATING TEMPERATURE:
835° F. — steam pressure 700 lbs.

REMARKS:
Outdoor location requires efficient insulation. Insulation on breeching must be weatherproofed.



Outdoor boiler suspended in air cuts installation costs

By suspending this boiler in air, the Public Service Company of Oklahoma, greatly reduced the cost of foundation footings, saved appreciably on construction costs. The suspension method also relieved the problems caused by expansion and contraction of boiler sidewalls.

This photo shows part of the supporting steelwork, as well as the breeching (left), and the spring loaded hangers that carry the main steam header.

To boost efficiency and cut operating costs, all major elements of this outdoor boiler were insulated by Armstrong's contracting organization. A 2" layer of Hy-Temp block was used on the boiler front wall, while the furnace front wall was insulated with 4" of Hy-Temp block. Insulation of both walls is covered with a metal casing bolted to the boiler proper. The breeching was insulated with 2½" of 85% Magnesia block and weatherproofed with Armstrong's Insulmastic.

When you contract with Armstrong for heat insulation work, sound engineering, quality materials, and skilled application assure you of a thoroughly professional job. The next time you're in the market for insulation, why not get in touch with this dependable organization. Just call the Armstrong office nearest you or write directly to Armstrong Cork Company, 7007 Maple Avenue, Lancaster, Pennsylvania.

Complete Insulation Contract Service

A satisfactory insulation contract is more than a bid on a set of specifications. There are other factors that cannot be written into a proposal but which can largely determine whether or not the agreement will be entirely satisfactory. They include:

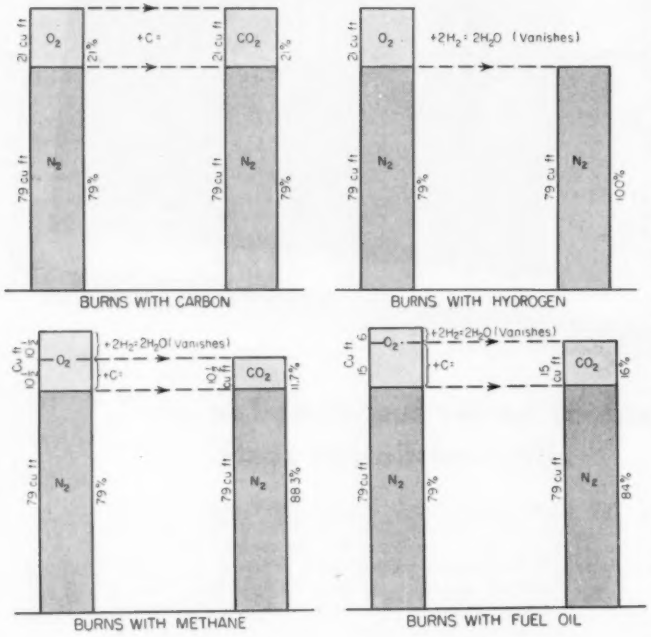
1. Financial responsibility — resources to complete the contract despite any unforeseen events.
2. Integrity—a reputation for quality work and for prompt settlement of any justified complaints.
3. Technical ability — experience, plus technical and research staff to complete the work in accordance with best practices.
4. Manpower resources — trained supervisors and workmen able to handle any contract efficiently.
5. Efficiency—ability to handle accurately things like accounting, tax provisions, insurance, and workmen's compensation.

You get all these with an Armstrong Contract

ARMSTRONG'S INDUSTRIAL INSULATIONS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Fuel oil computation is on oil in which hydrogen is $\frac{1}{8}$ of combustible

Then for 1 pound of combustible:

Oxygen to burn hydrogen	$= \frac{1}{8} \times 8 = 1.00$ lb	30%
Oxygen to burn carbon	$= \frac{7}{8} \times \frac{8}{3} = 2.33$	70%
	3.33 lb	

30% of 21 cu ft is 6 cu ft

Burning Carbon And Hydrogen Together

► WE HAVE TALKED about burning pure carbon and pure hydrogen, each separately. What if the two are combined in one fuel? For a starter, remember these points:

1. In combustion equations the gas molecules for hydrogen, oxygen and nitrogen are written this way: H_2, O_2, N_2. Reason: In each case the molecule has 2 atoms.

2. By volume, air is 21% O_2, and 79% N_2.

3. Oxygen that burns with carbon produces an equal volume of CO_2.

4. Oxygen that burns with hydrogen forms water (H_2O), which condenses, and so does not show up in volumetric analysis.

5. In combustion equations gas volumes are proportional to number of molecules of the gases concerned.

FOUR CASES

Now turn to the first sketch showing 100 cu ft of air used (without excess) to burn carbon. The 21 cu ft of oxygen turn to 21 cu ft of carbon dioxide. Total flue gas is 100 cu ft, so CO_2 is 21%.

Next burn hydrogen in the same way. All the oxygen disappears to form water. The flue gas is 100% nitrogen.

Then take methane, CH_4, the principal constituent of natural gas. Combustion equation is:

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$
$$1 \text{ vol} + 2 \text{ vol} = 1 \text{ vol} + \text{no vol}$$

Just for experience, check the atom balance to make sure no atoms are lost or gained in going from left side of equal sign to right side. You will find 1 carbon atom, 4 hydrogen and 4 oxygen on each side.

In this equation, note that the volume of CO_2 produced is half the volume of oxygen consumed. So flue gas contains 10½ cu ft CO_2 and 79 cu ft nitrogen. Total flue gas is 89½ cu ft, so CO_2 is 11.7%. This, then, is the highest CO_2 possible when burning methane.

The fourth sketch shows a typical fuel oil burned without excess air. The combustible is assumed to be one-eighth hydrogen (by weight). The rest is carbon. Final result is 16% CO_2 in flue gas.

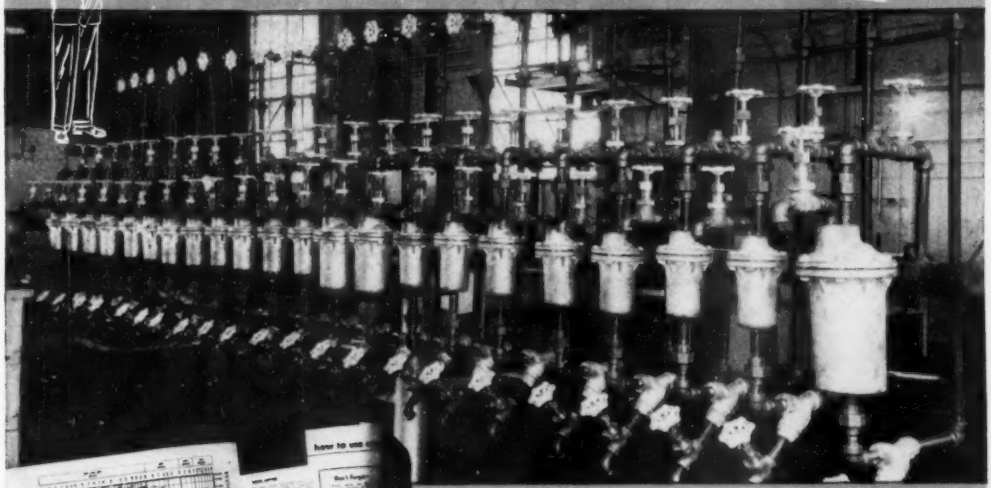
When you study the arithmetic below the sketch, remember that it takes 8 lb of oxygen to burn 1 lb of hydrogen—also that it takes 8/3 lb of oxygen to burn 1 lb of carbon.

So it takes 1 lb of oxygen to burn ⅛ lb of hydrogen, and 2.33 lb oxygen to burn ⅞ lb of carbon.

From this we figure that 30% of the oxygen supplied to burn this oil combines with hydrogen and disappears as water. 30% of 21 cu ft is 6 cu ft.

I hope this is clear; this fuel-oil computation is a little hard to follow.

No trial and error on that job....
ARMSTRONG TRAP DATA are Reliable



THE most carefully calculated installation of steam-heated processing equipment will fail to deliver full output if the steam traps do not have adequate condensate and air handling capacity. When this happens an important part of the capital investment in plant and equipment is wasted.

After you have figured the amount of steam that will be condensed, you need data on:

Condensate Capacity—not theoretical, not estimated, not cold water, but actual test findings with traps discharging condensate at steam temperature.

Trap Capacity Safety Factors, or ratio between continuous discharge capacity and actual amount of condensate to be handled. These may run from a low of 2 to 1 or as high as 8 to 1. Armstrong data tells you just what safety factor to use to obtain adequate air venting capacity and maximum heat transfer.

Armstrong trap data helps you get traps "big enough" for the job, but not too big; assures you maximum operating efficiency; eliminates corrections after installation. For traps and trapping assistance call your local Armstrong Representative, or write:

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

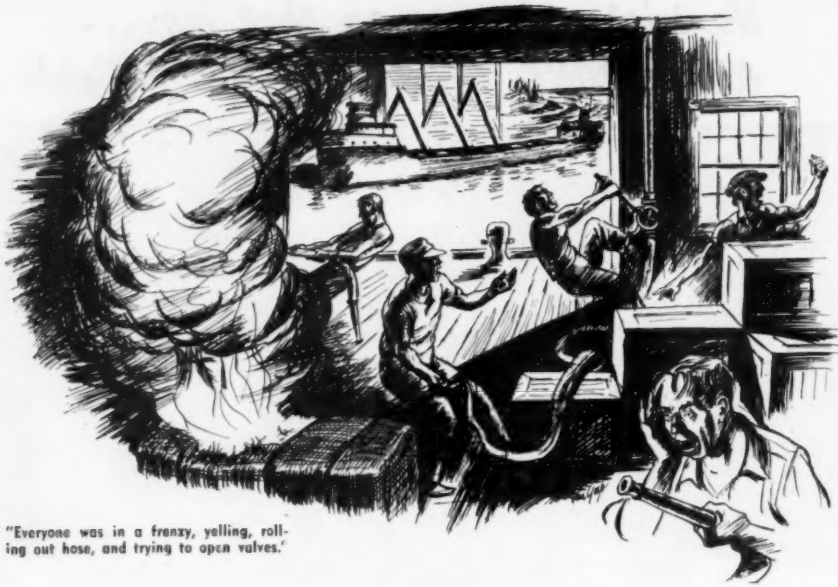
HERE'S AN EXAMPLE of the reliability of Armstrong data: Armstrong trap capacity figures are based on hundreds of tests with condensate at steam temperature. The choking effect of flash steam through the orifice as well as the back pressure created by flash steam were automatically taken into account. Actual backups were used to allow for the effect of pipe friction.

If the capacity ratings had been based on cold water tests, which produce no flash steam they would be too high. Orifice test ratings are too high because they ignore the effect of pipe friction. Slide rule calculations of trap capacities have never been conservative.

When you use Armstrong Data and specify Armstrong traps you know that you are getting the right trap for the job.

SEND FOR the new 44-page Steam Trap Book—including 14 pages of data on how to size Traps for nearly every type of equipment. Free on request—no obligation.

ARMSTRONG STEAM TRAPS



"Everyone was in a frenzy, yelling, rolling out hose, and trying to open valves."

Left Valves Are Not Right

► "Loss of $3,600,000 from forgotten closed valves after repairs," says one story in the current *Factory Mutual Record*. Still another says, "$200,000 loss when maintenance man forgot to reopen valve after replacing a sprinkler head." "$2,000,000 loss when valve was closed after dry pipe tripped because of air leakage," says a third. But why go on? They are all the same.

Insurance magazines are so full of these stories, month after month, that they get monotonous. Tragic part is that these plants are completely equipped with sprinkler systems, but some donkey closes a valve, making the system useless. And no warning is posted.

With an armful of insurance magazines, I dropped into Marmaduke Surfaceblow's office above O'Houlihan's Machine Shop & Engine Works. The old consulting engineer was busy looking at blueprints of a steam-engine foundation.

"Bilgewater on those stories," he roared when I showed them to him. "I'll tell you about a fire that had all these topped." He settled back into his swivel chair, propped his feet up on his rolltop and puffed away at his cigar butt.

"Back in 1930, I was chief engineer on the grain carrier *SS Susan Bower*," he bellowed. "On my first trip we tied up at a large grain-elevator and coal-loading dock on an island in one of the Great Lakes. Soon as we tied up and started loading, I ran into my old shipmate, Joe Bongiarno, from Ottawa. Joe had the day shift in the mill's powerhouse.

"That evening after work the two of us headed for the mainland to celebrate old times. And it's just as well we did. The grain elevator and storage bins were made of wood. But precautions had been taken to prevent explosions and fire. The place had signal bells, smoke alarms and all kinds of safety gadgets.

"Everyone in the mill was strictly forbidden to smoke. Penalty was being fired on the spot. And that meant moving out of their company house and off the island.

"The power plant had six coal-burning hrt boilers. Also, two small dc engines for lighting. A flywheel rope-drive ran the mill through a large 600-hp tandem compound engine. There was writer's fire pump run on 100-psi steam. The pump's 6-in. fire line ran from a 1000-gpm reciprocating steam underplant to mill, with various branches taking off. That included repair shops, freight shed and station house. All branches had 2-inch valves. And the plant had orders to keep 150 psi on the fire lines continuously. Whenever it dropped below that, a low-pressure alarm warned the power plant in a hurry. So far, so good.

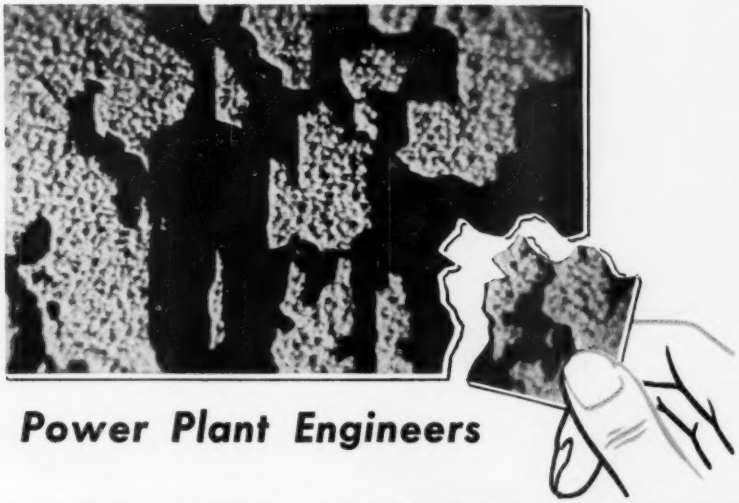
"This fire line had been built in zones. First zone was the grain elevator. But the piping ran through the freight shed without hose outlets. My friend pointed that out to the super, so outlets were put in. But the job wasn't according to Hoyle—not by a long shot.

"For one thing, the purchasing agent on the mainland discovered that he had a large batch of left-handed valves in stock. These were shipped to the island. The pipe fitter cursed those valves, and so did the super. But what could they do? Don't forget this was in the hungry 30s. So no one dared open his yap about those valves. The super did warn the truckers and foremen about the valves being left-handed. That was after they were installed. But that's the last anyone ever heard about them.

"There were no fire drills organized

(*Continued on page* 198)

JIG-SAW PUZZLE



for Power Plant Engineers

MAGNESIUM scale, magnified fifty times, can look like the jig-saw puzzle it often represents to plant engineers when it begins to affect boiler operation. Quick solution for this and any other scaling or corrosion problem is The Nalco System for your plant. High quality water treating chemicals, plus expert field and laboratory surveillance assure continuously successful results—now, and in the years to come, as long time Nalco customers will affirm. Write for your Nalco Water Treatment Survey today.

NEW DATA ON SCALE IN HIGH PRESSURE BOILERS

Reprints of "Experimental Studies of Boiler Scale at 2,500 p.s.i.," a paper presented at the 1950 Water Conference of the Engineer's Society of Western Pennsylvania, are available free upon request to Nalco. Article includes numerous photos of scale formations on test boiler tubes, and charts showing results of various water treatment methods.

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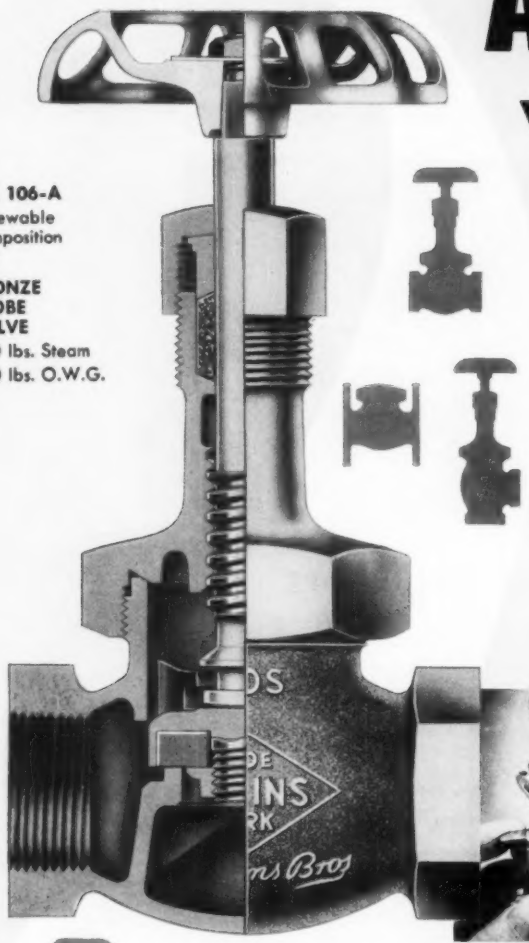
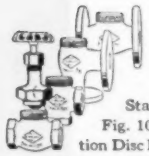


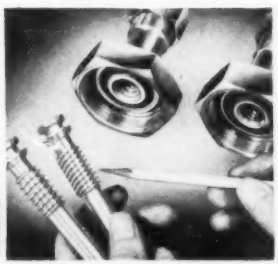
Fig. 106-A
Renewable Composition Disc

BRONZE GLOBE VALVE
150 lbs. Steam
300 lbs. O.W.G.



Starting with the standard Fig. 106-A Renewable Composition Disc Bronze Globe, a wide variety of valves can be made up by interchanging 4 bodies and a handful of parts. Trimming fits Globe or Angle body, screwed or flanged.

FOR CLOSE CONTROL — In throttling service, the nut which holds the disc in the disc holder is removed and replaced with Throttling Nut, Fig. 344.



FOR QUICK OPENING AND CLOSING — Merely substitute the bonnet and spindle from Fig. 941, in which threads are pitched more sharply.

INDUSTRY'S ALL-TIME FAVORITE, TOO, FOR LONG RANGE ECONOMY

It's easy to see why Fig. 106-A sets records for endurance. Liberal dimensions of body and bonnet permit repeated disassembly and reassembly without distortion. On the heavy, manganese bronze spindle, there are more threads in contact with the body, whether valve is open or closed. The disc holder fully protects the edge of the disc, prevents creeping, flaking, or cracking. Every part, from handwheel to pipe end hex, is a feature that contributes to record-setting performance.

Valves from ONE!

for 90% of industrial piping

4 bodies and a handful of parts

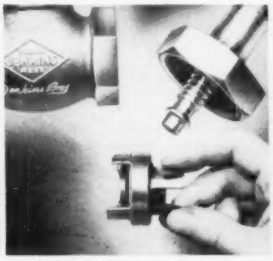
JENKINS FIG. 106-A "FAMILY"

Look over these pictures and see how easy it is to make up just the valve type you need, simply by interchanging parts. Think of the saving this means in maintenance expense . . . in reduced inventory of spare valves in your stockroom.

That's a big reason why the Fig. 106-A series takes top honors in any poll for valve preference. And, time-proved design makes them the longest-lasting, lowest-upkeep valves money can buy.

Remember, Jenkins Bros. is the originator of the renewable composition disc valve,—the *only* manufacturer of both valves *and* discs. For drop-tight, trouble-free performance, get acquainted with the Fig. 106-A "family". Despite their extra value, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17, N. Y. Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors.

FOR LIFT CHECK SERVICE — Globe or Angle Bodies can be fitted with interchangeable Cap, Disc Holder, and Guide Disc Nut from Fig. 117A. Addition of spring from Fig. 655A provides spring loaded service.



FOR STOP & CHECK SERVICE — Use the 106A trim, but substitute this spindle from Fig. 630A and replace the regular disc nut with the check valve guide disc nut.

SLIP-ON, STAY ON DISC HOLDER — Any valve in the Fig. 106-A family can be quickly restored to new, drop-tight operating condition by slipping on a holder containing a new composition disc.

JENKINS MAKES DISCS for every need. Valve is regularly fitted with hard disc for saturated steam service. Other discs are made for hot and cold water, air, gas, gasoline, oil, acids, and other fluids.

Ask your Jenkins Distributor for the 106-A Series folder, Form 189-A, and the "Guide to Correct Disc Selection", Form 191. Or write: Jenkins Bros., 100 Park Ave., New York 17, N. Y.

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

New scheduling form enables Defense Electric Power Administration to identify equipment on order, review and recommend adjustments in schedules. It also aids agency in scheduling production and delivery of major electric equipment through the National Production Authority.

New form DEPA–25 supersedes DEPA–5. It must be filed for any project requiring one or more of the heavy equipment items such as turbines, boilers, transformers, switchgear, etc.

Atomic Energy Commission has opened an Office of Industrial Development for the principal purpose of aiding industry participation in atomic-energy development. This will involve study of power generation and expansion of areas in which all types of industry may find an interest in the national atomic program.

Electric Power Committee has been appointed to maintain close and continuing coordination of government agencies involved in the power program. James F. Fairman, administrator of DEPA, is chairman. Members are Franz Stone, deputy administrator of NPA and Albert J. Carey, Defense Production Authority.

The committee will make periodic reports to DPA and will recommend to DPA and NPA means for presenting a coordinated picture of materials and equipment necessary for the approved power program.

With nickel still tight, NPA sees no chance of relaxing prohibitions on use of nickel-bearing stainless steels. There's need for even more stringent restrictions, they say. Supply of chromium stays about in balance with needs.

Non-ferrous scrap needs are detailed in a new booklet issued by NPA. It also outlines steps taken to increase recovery. Scrap drive is aimed at industrial executives who can: (1) determine what can be scrapped (2) order scrap disposal (3) arrange to have obsolete equipment written off (4) put scrap collection and disposal on a month-to-month basis.

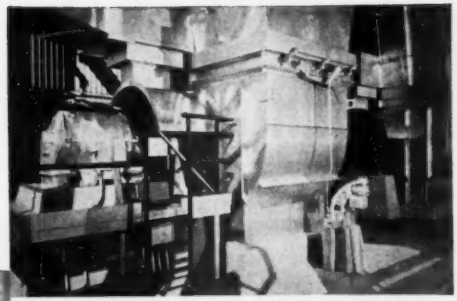
Steam-turbine deliveries hit 98.2% of schedule during first quarter. Nevertheless, builders are concerned over delivery lags in throttle valves, large forgings and castings. NPA is considering priorities for castings of 5 tons or more.

NPA sees need for more switchgear production capacity in 1953 and 1954, but industry studies dispute this. A task force will examine the problem.

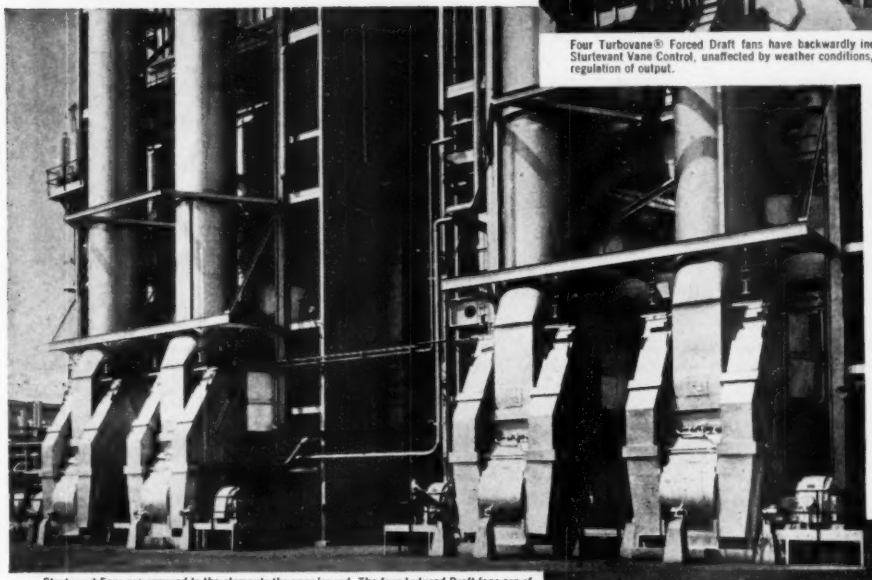
Underground oil storage is practical, says a National Petroleum Council committee. It can be developed in many parts of the country for stockpiling to meet industry's growing requirements or emergency needs. Using underground cavities or mining at suitable sites can prove less expensive in steel and manpower than usual above-ground storage facilities.

Electric power projects to receive certificates of rapid tax amortization now total 419, promise to add close to 18 million kw to U.S. capacity. This reflects a shift from emphasis on basic materials (steel, chemicals, etc.) to public utilities as the mobilization program matures. Up to Feb. 25, utilities had received only 9% of the total tax-amortization program. Between then and April 15, the power program's share rose to 14% of the total.

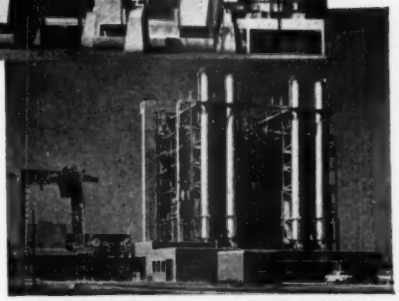
Sturtevant Fans Engineered for OUTDOOR INSTALLATIONS



Four Turbovane® Forced Draft fans have backwardly inclined blades. Sturtevant Vane Control, unaffected by weather conditions, gives instant regulation of output.



Sturtevant Fans are exposed to the elements the year 'round. The four Induced Draft fans are of the Multivane® type with forwardly curved blades. Control is by intake dampers.



Only structural steel framework surrounds the boilers and stacks at Arkansas Power and Light's new Hamilton Moses Station, Forrest City, Arkansas. Elimination of enclosures brings substantial savings in construction costs, an economy that helps this company hold the line against higher rates.

Outdoor service has put new demands on mechanical draft apparatus—protection from temperature extremes, dust, salt-air corrosion, rusting from rain or snow. Smooth, dependable operation of bearings and mechanisms must be maintained regardless of exposure to the elements.

In the new Hamilton Moses Station, Arkansas Power and Light's eight Sturtevant fans will perform under all kinds of weather. These fans are expertly engineered and sturdily built of heavy steel plate and welded construction. They have sealed-in bearings that protect against atmospheric changes. On the forced draft fans, for example, Vane Control® has a simple link and lever action which allows easy operation in all kinds of weather, requiring no interior lubrication.

Whatever conditions your mechanical draft equipment must meet, there's a Sturtevant fan to satisfy the requirements. For over 90 years, Sturtevant has meant satisfaction in mechanical draft. Get complete information from your local Westinghouse-Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

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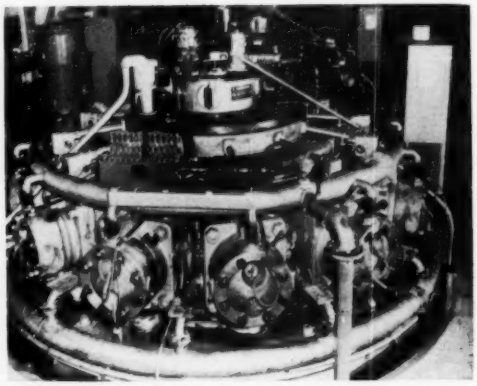
READER SERVICE SECTION

POWER NEWS 148
TECHNICAL BRIEFS 150
PLANT EQUIPMENT NEWS 154
NEW FREE BULLETINS 163

NEW RADIAL ENGINES are in two power houses, with 37 units each. There are individual controls, disconnects, oil filters



12-CYLINDER ENGINE develops 9% more power than older 11-cylinder unit, with same bore, stroke, ignition, general design

Point Comfort Gas Engines Total 350,000 Hp

► ALUMINUM CO OF AMERICA installed 74 new gas-fueled engines at their Point Comfort (Texas) Works. This raised the rating of the world's largest internal combustion engine generating station to 350,000 hp, and the plant's aluminum producing capacity is up to 85,000 tons annually.

The new units are similar to the 120 original ones, but they have several design refinements. (See POWER, July, 1950, pp 76-81, for photo-tour of the original installation, design features, and plant layout.)

Nordberg Mfg Co built all 194 engines. They are 2-cycle, radial type, have advanced design of dual spark ignition, 14-in. bore and 16-in. stroke. But the 74 new engines have 12 cylinders instead of 11, and since the cylinders are the same size, the new model develops about 9% more power.

A new stabilizing mechanism in the new engine lets the master crankpin bearing assembly gyrate but prevents it from rotating in response to torque from the connecting rods. In the original 11-cylinder engines planetary gears took care of this. Nordberg substituted a simple crank mechanism operating between two connecting rods and their knuckle pins in the new engines. The relatively small torque tending to rotate the master crankpin bearing assembly is absorbed by small reactions on two of the pistons.

Although the same impulse generator is used for ignition on both model engines, it and the distributor are a single unit in the new model, instead of being driven separately, as before.

Except for these changes, the two engines are essentially the same. In both models, the pistons time the intake and exhaust by uncovering ports in the cylinder walls. There are no intake and exhaust valves in either model.

Natural gas comes in through cage-mounted gas valves that are operated by a cam on the crankshaft. The gas flows into the path of the incoming scavenging air, assuring thorough mixing and efficient, economical fuel burning. A valve in the gas line, controlled by a hydraulic governor, varies the amount of gas delivered to the cylinders according to the load on the engine.

Alcoa has found that the compact cylinder arrangement of the engine simplifies maintenance. All bearings are renewable bushings, and the heads, pistons, cylinders, and bearings are interchangeable. This cuts down the number of spare parts that are necessary.

Seventy-four Elliott electric generators are in the lower level of the two new power houses, and are joined to the engines by direct coupling. Each engine-generator unit, with its auxiliaries, operates independently.

Each generator produces 1100 kw (dc) at 667 v, and 135 kva (ac) at 425 v, 24 cycles. The ac power drives auxiliaries like the scavenging air blower, oil and water pumps, radiator cooling and generator ventilating fans. There is no need for a common auxiliary power system and no possibility of a total station interruption.

As in the original plant, each engine-generator unit has its own control panel. Both the basic engine shutdown and protective features, and the auxiliary equipment for the new units are essentially the same as the original installation.

For Coming Events turn to page 184

Copes and Vulcan Divisions Combined, Expanded

Demonstrating confidence in the continued growth and prosperity of the power field, Continental Foundry & Machine Co has completed a series of steps that will more than double production of the Copes

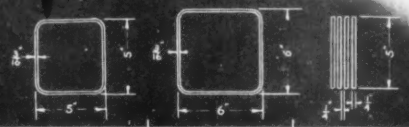
(*Continued on page* 184)

save copper

CHASE Ventilated Square Bus Conductors cut copper needs up to 36%

Look at the weight savings when you use Chase Ventilated Square Copper Tube Bus Conductors. The table below tells the story.

Also—the ventilating holes give 20% more current carrying capacity. Get full information about efficient, strong and easy-to-install Chase Ventilated Square Copper Tube Bus Conductors. Send coupon for the free booklet.



Sizes	5" Square Tube Ventilated	6" Square Tube Unventilated	4-5"x¼"x¼" Flat Bars
Sq. in. metal area	3.20	4.15	5.00
Weight, lbs. per ft.	12.42	16.08	19.38
Amperes load	3350*	3350**	3350
Amperes/sq. in.	1047	807	670
Amperes per lb. per ft.	270	208	173
% Copper saved	36	17	

For higher currents these differences will be still greater.

*Good for 3720 amperes. **Good for 3700 amperes.

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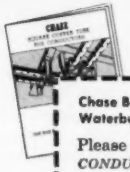

FREE Chase Copper Bus Conductor booklet gives physical and electrical characteristics and data on copper saving.

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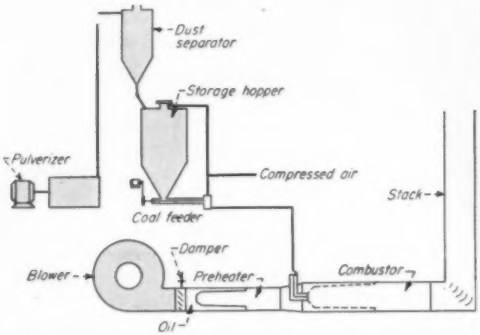
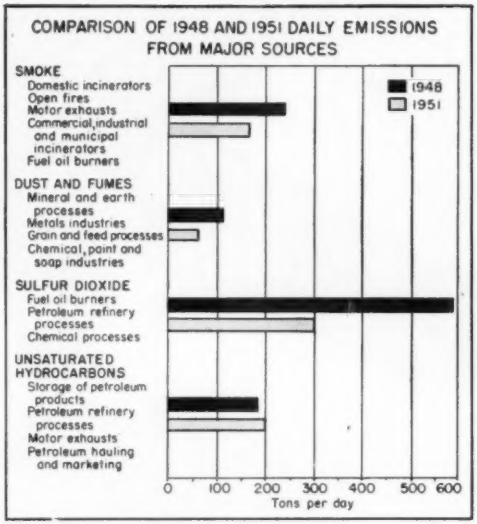


COAL PROPERTIES obviously affect combustion. Set-up, above, was connected to find answers for the gas-turbine combustor

COMPARISON between atmospheric pollutants in Los Angeles County area between 1948, 1951 shows encouraging progress →



Gas Turbines

Different Rank Coals in a Gas-Turbine Combustor. *By T E Warren, H P Hudson, J D Robertson, and J C Mulligan, Dept of Mines and Technical Survey, Ottawa, Canada.*

Technical problems involved in construction of a coal-burning, gas-turbine locomotive have been investigated during the past 5 years by the Locomotive Development Committee of Bituminous Coal Research, Inc, under the direction of John I Yellott. The committee has concentrated on adapting the open-cycle gas turbine to coal firing. This cycle has the advantage of direct heating of the working gas but requires developing suitable means for feeding coal into the combustor, burning it under pressure, and removing ash before it hits the turbine blading. Studies in diverse fields of technology have been necessary and some of these have been assigned to established research organizations.

The effect of variation of coal properties on combustor performance was investigated by the Fuels Division of the Mines Branch, Dept of Mines and Technical Surveys, at Ottawa, Ontario. The present paper reports on tests (see fig.) by the Mines Branch on 23 bituminous coals of various ASTM classification by rank.

Combustion efficiency in a film-cooled combustor proposed for coal-fired gas-turbine locomotives varies greatly with change in coal rank. Tests indicate that bituminous coals of the high volatile A, B, and C groups will, in general, give satisfactory performance. Coals of higher rank appear to be unsuitable because of low combustion efficiency. Tabulating the coals tested in order of efficiency placed them in descending order of rank.

A definite trend toward higher efficiencies with higher volatile and high heat contents is evident from the test data. So you can safely say that coals of low rank, high-caloric value, volatile and high volatile content will prove satisfactory in a combustor of this type operated at atmospheric pressure.

To get satisfactory combustion of the higher rank, lower volatile coals, burner design changes appear to be necessary. Some increase in efficiency can be expected by operation under pressure. But for efficiencies constantly around 85-95% over the full range of North American coals considerable modification will be required. This may be expecting too much of any given combustor when you consider that any other existing combustor is designed to burn fuel that will fall within a comparatively narrow band of variable properties. *ASME paper. No. 52-SA-4.*

Centrifugal Compressor for a Small Gas Turbine Compressor. *By Ivan E Speer, AiResearch Mfg Co.*

Other starting devices for turbo-jet and turbo-prop engines became more important as starting power requirements began to get higher than could be handled by electric starters of reasonable size and weight. This led to interest in the pneumatic starter. To make it practical a small, lightweight source of compressed air had to be developed. A gas turbine compressor (designated GTC) with all the useful output taken as compressed air, was suggested.

This put several requirements on the

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

The old packing gives the clue to most packing failures...

I was ruined by shaft misalignment. When old packing shows excessive reduction in cross-section directly beneath rod, shaft or plunger, bad alignment is indicated. Leakage usually occurs around top of shaft or rod. Cause may be worn bearings which permit shaft to whip.

Too much gland pressure did me in. Badly deformed rings next to the gland follower, with bottom rings in fair condition, suggest excessive gland pressure or improper installation. Excessive gland pressure sometimes causes packing to extrude between follower and rod or shaft.

Lack of lubrication made things too hot for me. If the wearing faces of the rings are dried out or charred, with the rest of the packing in usable condition, the trouble probably is lack of lubrication. Excessively high operating temperatures and wrong type of packing can cause similar symptoms.

I'm worn out because I turned with the shaft. Unusual wear on the outside circumference of the packing almost always indicates one of two conditions. The rings may be binding on the shaft and rotating with it, or the packing is too loose in the stuffing box and moving with the rod.

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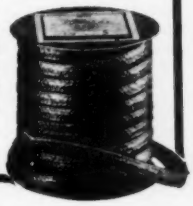
INTERLOCKED ROD PACKING

Because it's braided square, not braided round and pressed square, J-M Interlocked Packing lasts longer . . . has a better contact area . . . makes a tight seal with medium gland pressure. J-M Interlocked is recommended for both reciprocating and rotating service, for use against steam up to 500°F; hot and cold fresh and salt water; oils; weak acids and caustics.



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More TECHNICAL BRIEFS

Begins on page 150

compressor not ordinarily of prime importance on a shaft power or thrust producing gas turbine.

Broad flow range and efficiency became the basic objectives for design and development. The author shows that highly backwardly curved impellers, designed according to the reasoning presented, have the required characteristics. Results of the development program show that the objectives can be met and exceeded. *ASME paper. No. 52-SA-14.*

Some Investigations With Wet Compression. *By J T Hamrick and W L Beede, National Advisory Committee for Aeronautics.*

This paper presents the results of experimental investigations on several centrifugal-flow compressors using water injection. In addition, mechanical considerations, special instrumentation, and theoretical aspects are discussed and a method of computing adiabatic efficiency with wet compression is presented.

Water injection in both jet and reciprocating engines has achieved varying attention over the past two decades. It has been successfully applied in specific cases in both the U.S. and foreign countries. The literature has been vague about the theory of water injection applied to compressors; and in the case of reciprocating engines, the main effort has been to eliminate knock rather than to improve supercharger performance.

With both types of engines, water injection has been used for augmenting normal power over short periods and not in a continuous application. One primary reason has been the requirement of a large quantity of water. You can appreciate this factor if you consider a turbo-jet engine injecting water equal to 5% of the air weight flow. For an engine using 100 lb of air per second the water required would be 18,000 lb per hr—about the same weight as the aircraft that would use such an engine. Recovering water from the exhaust gases is discussed and although using the required equipment appears impractical for aircraft, it might be feasible for stationary gas turbine engines. *ASME paper. No. 52-SA-15.*

Atmosphere

Second Technical and Administrative Report, Air Pollution Control, Los Angeles County. *G P Larson, director, Los Angeles, Calif.*

The Los Angeles County Air Pollution Control District is responsible to the community for correcting the vexatious conditions created by smog. The final solution to air pollution problems in this and other densely populated or highly industrialized areas depends upon thorough understanding of the causes and effects of polluted air. (See fig. page 150.)

The last annual report set forth the role of smoke, dusts and fumes in reducing visibility, and explained the methods used for controlling these contaminants at the source. The engineering program has resulted in marked progress in this field.

Research studies previously reported by the District and its associates presented the investigations then under way to explain the causes of crop damage and eye irritation. Progress in these studies has made a major contribution to the understanding of smog's physical and chemical properties. It is now possible to explain most of the observed effects caused by polluted air and to account for the sources that are responsible for most of the smog.

This annual report is prepared to further the knowledge in this complex field. Copies obtainable only through *Air Pollution Control District, Los Angeles, Calif.*

Cloud Seeding in the Sierra Near Bishop, California. *By Ferguson Hall, T J Henderson and Stuart A Cundiff, California Electric Power Co.*

California Electric Power Co has carried out cloud seeding operations in the High Sierra near Bishop, Calif., since February 1948. They use dry ice dispensed from aircraft. Limited visual observations suggest that snow showers can be produced for non-precipitating orographic clouds by seeding, the snow reaching the ground at the higher elevations, rather than in valleys.

By comparing the seasonal and annual run-off from the seeded watershed with that from adjacent areas, they estimate that the average annual run-off during 1948, 1949 and 1950 was augmented by 9%. Most of the increase appeared in 1949. Similar comparisons of snowpack did not indicate a significant increase in the Bishop area. But past experience suggests that additional precipitation might have been produced that was not reflected in the snow surveys. *American Meteorological Society Paper. 115th National Meeting. No number. (Available through AMS, 5 Joy St., Boston 8, Mass.)*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source not POWER.

American Power Conference, first annual meeting, Sherman Hotel, Chicago, Ill. March 26-28, 1952. Identified by initials APC and obtainable in the Proceedings through R A Budenholzer, Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill. $6.

American Society of Mechanical Engineers, spring meeting, Univ of Washington, Seattle, Wash. March 24-26, 1952 and the semi-annual meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio, June 15-19, 1952. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Association of Iron and Steel Engineers, annual spring meeting, Netherland Plaza Hotel, Cincinnati, Ohio, April 28-29, 1952. Identified by initials AISE and obtainable through T J Ess, secy, AISE, Empire Bldg, Pittsburgh, Pa.

Fuels and Firing

Burning Sulfite Waste Liquor. *By H A Sorenson, State College of Washington.*

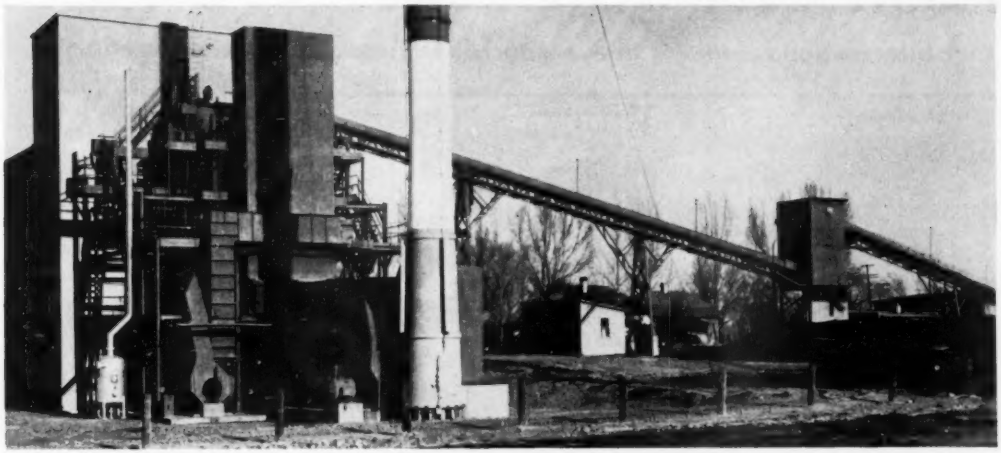
The combustion of sulfite liquor, discharged from paper mill digestors, is usually considered a solution to the problem of waste disposal. Owing to substantial dilution by wash water the liquor blown from the digestors has a solid concentration of 10-12%. Thus, proposals for possible use of this material must provide for local application or processing, since extended transportation of water is uneconomical. To date, only a small fraction of the sulfite liquor output can be effectively and economically used.

Early in 1950, the Division of Industrial Research at the State College of Washington undertook a study of the combustion of waste sulfite liquor.

They found conflicting opinions. Some investigators felt the only problem was evaporation of the dilute liquor to obtain a concentration of 50-60% solids

(Continued on page 190)

FAIRFIELD SERVING THE NATION'S POWER PLANTS



Coal by "belt express" for

The Western Colorado Power Co.

Shown above and below are scenes from one of Fairfield's latest coal handling installations—at work for the Jim Bullock Plant of The Western Colorado Power Company, Montrose, Colo., a wholly owned subsidiary of Utah Power & Light Company.

This typical Fairfield system involved a track hopper, 156′ belt conveyor to crusher house, crusher equipped with 2-way hopper for either ground storage or boiler house bunkers, another 130′ belt conveyor to boiler house, and a self-propelled automatic belt tripper above boiler house bunkers.

Whatever your particular coal handling needs, Fairfield offers a complete service of engineering, manufacturing and erecting complete systems—one responsible source for installation economy and control. Make it a point to call in a Fairfield Sales Engineer to discuss your handling problems—complete facts and the name of your nearest Fairfield Engineer is available on request—write today.

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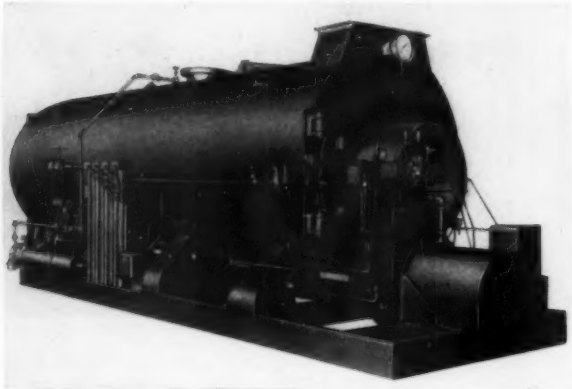


STEAM GENERATOR HAS GUARANTEED HEAT TRANSFER

P722 • *Cyclotherm* steam generator features guaranteed heat transfer. Produces a boiler hp (34.5 lbs of steam per hr at and above 212 F) for every 3 sq ft of heating surface. Capacities from 720 to 20,000 lbs per hr, 15 to 200 psi. Air enters the combustion chamber at a high velocity, mixes with incoming fuel in a spiral fashion along the entire length of the furnace. This controlled vortex gives a highly effective combustion rate and is said to allow full power from a cold start in 15 to 20 minutes.
Cyclotherm Div, United States Radiator Corp, Oswego, N. Y.

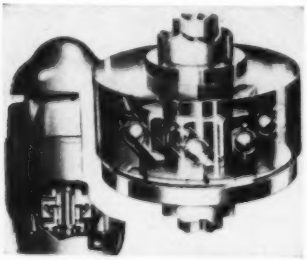
REFLASH STEAM SEPARATOR

P709 • Recovering excess heat from flash steam and putting it to work in low-pressure heating or process lines means real savings in plants having large amounts of high-pressure condensate or continuous blowdown. This separator is available in different sizes and is easily installed. Discharge line from high-pressure traps is run to separator which connects to low-pressure main. Water that remains after flashing is returned to boiler, put through a heat exchanger or discharged to sewer.
Strong, Carlisle & Hammond Co, Cleveland 13, Ohio

PENDANT PUSHBUTTONS

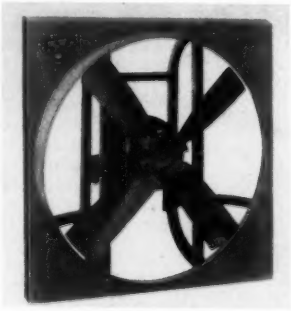
P737 • Bulletin 800T pendant pushbutton station is a new oil-tight control station. It is designed for use as a portable control or for suspension above a machine where it may be easily reached while the operator is near his work.

Pendant pushbutton stations may be obtained in sizes having three units including the stop, to 10 units including the stop. Standard stop unit is a wobble stick in the bottom of the enclosure, but can also be furnished as a mushroom head mounted in the bottom or front of the enclosure.
Allen-Bradley Co, Milwaukee, Wis.



VERTICAL-MOTOR BACKSTOP

P734 • *Ballomatic* backstop, for vertical hollowshaft motors, prevents motor reversal. When the motor starts, centrifugal force throws the hardened steel balls out of engagement with the stationary member. When it stops, gravity pulls the balls down to engage between the rotating member and the stationary rachet.
U S Electrical Motors, Inc, 200 E Slauson Ave, Los Angeles 54, Calif.



PROPELLER FAN

P735 • Heavy-duty direct-drive propeller fan is suitable for many industrial uses such as air supply and exhaust, mine ventilation and filtering units where large volumes of air are needed under static pressure. Sizes range from 16 to 48 in., capacities from 2900 to 37,000 cfm. Motors are totally-enclosed ball-bearing units. Fan blades are made of cast aluminum and are non-overloading airfoil-type.
Chelsea Fan & Blower Co, Inc, 639 South Ave, Plainfield, N.J.

LEVER SWITCH

P736 • Miniature telephone-type lever switch, *Type MCS*, is well suited for use in instruments, radio equipment and communication systems. Lever action is smooth and incorporates lock, non-lock, and no-throw positions. Handle is bakelite and contact springs are nickel-plated phosphor bronze. Contacts are pure silver and are riveted to springs. Silver-palladium alloy contacts also available.

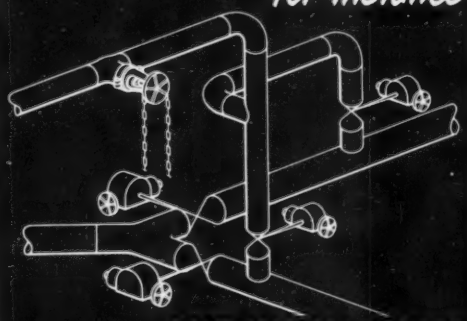
Contacts are rated at 1 amp, 110-v ac, 60-cycle non-inductive load. Each switch is tested to withstand 1500-v ac, 60-cycle between the contacts and the frame.
General Control Co, Boston 34, Mass.

(*Continued on page* 156)

For more data on these items, use post cards, p 163. Identify request with P and number.

Can You Rate Your Valves This Well?...

on Main Steam Service for instance



THE INSTALLATION

Crane Pressure-Seal Gate Valve on 8-inch main steam lead to house turbine. Steam conditions: 850 psi at 900 Deg. F. Southwark Station, Philadelphia Electric Co.

VALVE SERVICE RATINGS

MAINTENANCE COST:	None to date
FEATURES:	Highly practical Pressure-Seal design
SUITABILITY:	Eliminates bonnet joint leakage
SERVICE LIFE:	Now more than 4 yrs.
PRICE:	In line for this modern design
AVAILABILITY:	Regular item in Crane line

THE HISTORY

This valve was installed on a trial basis in the station's last extension program. In service now more than 4 years, this 900-Pound Crane Pressure-Seal Bonnet Gate Valve has completely eliminated any need of bonnet joint maintenance. Under constant high pressure/high temperature conditions, it remains perfectly tight at bonnet and stem; needs no costly attention.

Never, says the customer, does this Crane valve stick at the disc, even though operated infrequently. Its operation is as smooth and positive today as when first installed. As a result of this performance, the customer is continuing to specify Pressure-Seal type valves.

THE VALVE

Universally recognized for simplified development of the modern pressure-seal bonnet principle, Crane Pressure-Seal Gate Valves combine many added refinements. For example, their highly compact, weight-saving design reduces erection costs; streamline body contouring saves insulating labor and material. See your Crane Catalog or Crane Representative for complete details on these valves—in gate, globe, angle, and stop-check patterns; in 600, 900, and 1500-Pound pressure classes.

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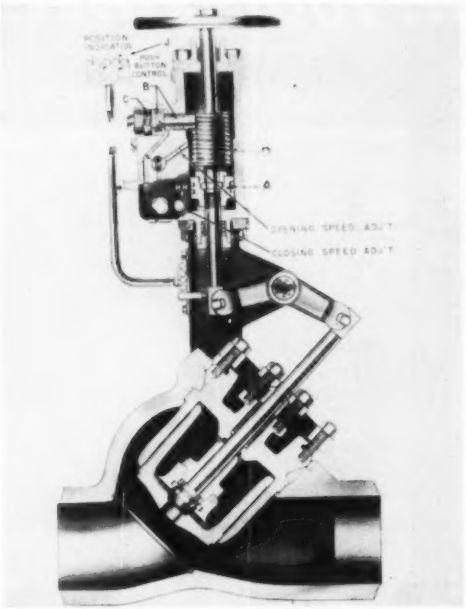


FLUID POWERED VALVE IS HAND OR REMOTE-OPERATED

P733 • Type C valve is hand operated, or remote operated by condensate under boiler pressure (or by oil if desired). Major feature is small pressure-equalizing by-pass valve centered in main valve. In manual operation acme threads on spool D mesh with threads on piston B.

In remote-control operation pressing the "open" button admits condensate under pressure above piston A. The same pressure acts on the annular space at the right of piston B to withdraw the acme threads on piston from those on spool D.

The resulting movement of the valve stem first opens the small central valve, thereby balancing the steam pressure on both sides of the main valve so that it requires only a slight force for opening.

Pressing the "close" button energizes another solenoid that admits condensate below piston A to close the valve. Here also the pressure is simultaneously transmitted to piston B to free it from the thread on spool D. When closed, main valve is completely unbalanced.

To minimize pressure drop in operation main valve body is nearly spherical and valve seat area is at least 25% larger than pipe cross-section area. The main valve disk is readily removable without interfering with the upper mechanism.

Wherever a ¼-in. steam line can be run to a small condensate tank beside the valve (or group of valves) condensate under pressure is conveniently available as a power fluid to operate the valves.

Where no steam lines are near (or for outside cold-weather service) use Type O valve. Its operating fluid is light oil pumped by a small valveless gear pump driven by a fractional hp motor. One oil pump can handle a group of valves.

Ludeman Valve Co, Graybar Bldg, 420 Lexington Ave, New York, N.Y.

INDUSTRIAL TORCH

P720 • Rugged, lightweight (2½ lbs), *Bazooka* torch has a self-cooled adjustable pistol-grip handle; comes complete with a hose assembly. It produces a flame range from a soft, lapping flame of 5 in. long and 1 in. dia to a large, hard blast of 20 in. long and 5 in. diameter.

Industrial Engineering Products Co, 7416 Melrose Ave, Los Angeles 46, Calif.

For more data on these items, use post cards, p 163. Identify request with P and number.

GRAVITY-FEED OILER

P738 • Designed to feed predetermined drops per minute, this unit is now available in 10-oz, 1-pt, 1-qt and 2½-qt capacity. Pyrex glass or Lucite plastic reservoir. Suitable for large stationary bearings, conveyor drive chains, etc.

By holding lever at 45 deg, oiler will flush the bearing. This is a desirable feature when starting machines that have been idle for an extended period.

Trico Fuse Co, 2948 No. 5th Street, Milwaukee 12, Wis.

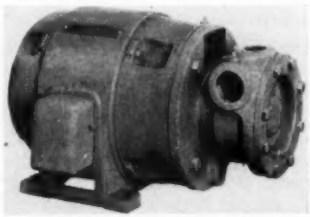
FLUORESCENT LAMP

P726 • Fluorescent lamp starts quickly and smoothly without external starters. Named *Rapid Start*, it will be used with specially designed ballasts intended for new lighting systems. Now made in the 40-w size, in standard cool-white. Other colors are planned.

Overall lighting cost of the improved system is comparable with the 40-w preheat-start system in general use today. In a *Rapid-Start* system, all lamps controlled by one switch will light promptly—within about one second. Lamps will not blink or flicker at any time throughout their lives. Because there are no starters, the system will be comparatively easy to maintain. Lamps operate in series, two on one ballast.

They differ from conventional preheat fluorescent lamps in two principal respects: They employ a complex, triple-coiled cathode (the part of a fluorescent lamp that conducts electricity from wires to gas). They also use a water-repellent coating to insure reliable starting under high-humidity conditions.

General Electric Co, Nela Park, Cleveland 12, Ohio.



TURBINE-VANE TYPE PUMPS

P702 • Type TVE is a close-coupled pump, face-mounted on motor; type TVB is a flexible-coupled electric-drive unit. Both types are available with or without a self-priming device. These units are for pumping hot and cold, clear and vaporous liquid in moderate capacities against medium or high heads. Maximum capacity at 3500 rpm is 58 gpm, head 800 ft.

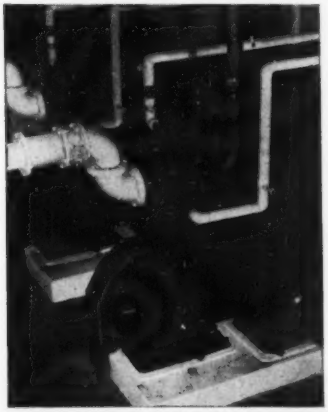
Peerless Pump Div, Food Machinery and Chemical Corp, 301 W Ave 26, Los Angeles 31, Calif.

(*Continued on page* 158)

It's JOY for OIL-FREE AIR

Above: Joy WNO-112 Oil-Free Compressor

Below: Joy WGO-9 Oil-Free Vertical Compressor



Note some of the reasons why

★ Special lightweight pistons minimize wearing pressure on the rings.

★ Ease of disassembly facilitates inspection of pistons, rings, cylinder liners and valves.

★ On-the-job-replaceable chrome-plated cylinder liners for hard, smooth, friction-reducing surfaces, and field replaceable crosshead guides.

★ Carbon graphite compression rings designed to compensate automatically for wear.

★ Large, direct air passages and liberal water-jacketing reduce heat of compression and increase ring life.

★ Patented Dual-Cushion valves, all parts of which are made from corrosion-resistant materials.

★ All wearing areas, except carbon rings, are either chrome-plated, surface hardened, or of stainless steel.

★ Complete line of types and sizes of compressors to meet *any* capacity and pressure requirements. ● *Let us quote on your air supply needs of any nature.*

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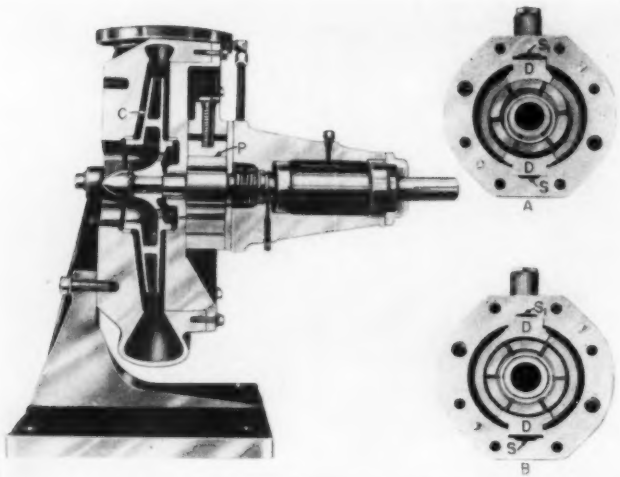


CENTRIFUGAL PUMP HAS BUILT-IN SELF-PRIMER

P743 • This self-priming centrifugal pump has a volute casing, a closed impeller *C* and a positive-displacement priming pump *P* built into it. Of the sliding-vane type, the priming pump has its rotor keyed to the centrifugal pump's shaft. A sliding block *D*, Fig. A and B, acts as a bore for the sliding-vane rotor and fits into ways in the pump's casing. Space *S* at the bottom end of the slide connects to discharge-pressure of the centrifugal pump, and space S_1 above the top slide connects to suction pressure, giving the block its motion.

When the pump is not primed discharge pressure is low, so that a spring above the top slide forces the sliding block off center with the rotor, Fig. A, to put the priming pump in operation. When the centrifugal pump primes, discharge pressure under the bottom slide *S* increases to where the primer's bore is forced vertically until it is concentric with the rotor, Fig. B.

In this neutral position the priming pump is practically inactive and remains that way as long as the centrifugal pump is primed. If the main pump loses prime, pressure at *S* drops and the spring forces the sliding block down to automatically put the priming pump in service again to keep the centrifugal primed.

These pumps built primarily for handling petroleum products are available in capacities of 50 to 450 gpm and heads up to 130 ft. A new model is being developed for 700 to 1100 gpm with or without the self-priming feature. When operating wet the priming pump has developed a vacuum of 27 in. of mercury.

Gilbert & Barker Mfg Co, West Springfield, Mass.

VARIABLE SPEED MOTOR

P739 • *Type KFEA* variable speed units with single reduction gears in ratings of 20 and 25 hp are made in speeds of 728 rpm and lower with infinite speed adjustment within the ranges 2:1, 3:1 or 4:1. Shown is 25 hp single reduction model having speed variation of 4:1 and output speeds of 324 to 81 rpm.

Features of the drive are: positive adjustment of pulleys, accurate maintenance of speed under varying loads, belt tension proportionate to load, positive oil seals, single train helical gears, herringbone rotor, and direct-through ventilation. All ratings are available with drip-proof or splash-proof construction.

Sterling Electric Motors, Inc, 5401 Anaheim-Telegraph Rd, Los Angeles 22, Calif.

For more data on these items, use post cards, p 163. Identify request with P and number.

INSTRUMENT PEN

P740 • Removable tips plus new reservoir construction feature industrial instrument pens said to eliminate flooding, choking and paper plugging. There is less pressure on the chart. The tip screws on the capillary neck with a threaded connector and ties into the reservoir. Pen tip can be readily cleaned by passing a small diameter wire through it from the back. Entire pen assembly has mounting ears that slip over pen carriage bracket, can be conveniently removed when necessary.

Brown Instrument Div, Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

TURBINE-DRIVE

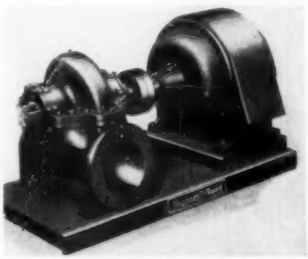
P741 • Single-stage, impulse, double-impact steam turbines *type DH*, direct steam against a single row of blades twice by special steam-reversing nozzles. No high-pressure steam comes in contact with the casing and all high pressure parts and joints make up outside where they are readily visible and easily maintained. Turbine can now develop 1000 hp at pressures up to 875 psi and 750 F. Unit is well adapted for mechanical drives with pumps, fans, blowers, generators.

Dept J, Dean Hill Pump Co, 4000 E 16th St, Indianapolis 7, Ind.

SPUR-GEAR HOIST

P742 • Easier servicing and greater strength and resistance to shock-load breakage result from housing of formed steel plate in new ½ and 1-ton capacity spur gear hoists. Weigh 39½ lb including standard length of high-strength coil chain for 8-ft lift.

Coffing Hoist Co, 800 Walter St, Danville, Ill.



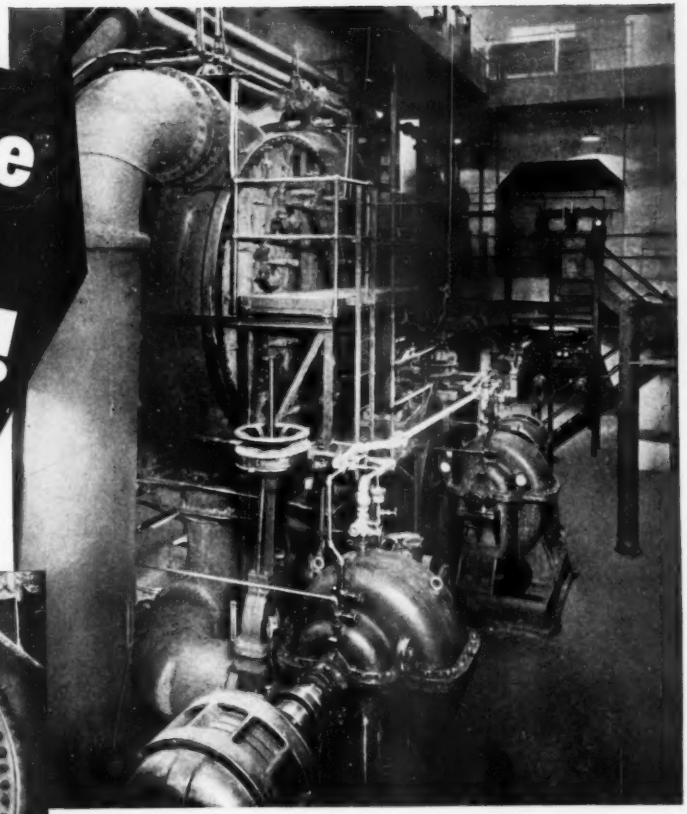
SINGLE-STAGE PUMPS

P707 • Class DMV-DHV single-stage double-suction pumps are compact totally-enclosed units requiring minimum attention and maintenance. Sizes are 3, 4, 5 and 6 in., capacities range to 2100 gpm, pressures to 150 psi, temperatures to 200 F. Features include double mechanical shaft seals and prelubricated ball bearings. Three spare parts kits serve all eight pumps in the line, permit easy overhauls.

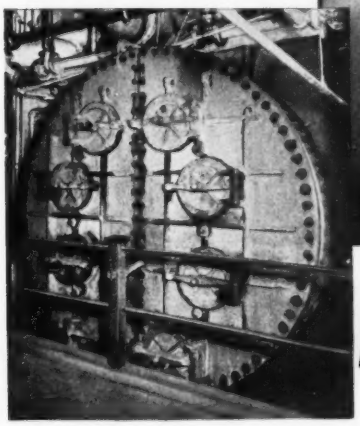
Ingersoll-Rand Co, Dept CAM, 11 Broadway, New York 4, N. Y.

(*Continued on page* 160)

Before you SCRAP!



Condenser of the Lynn Gas & Electric Co., Lynn, Mass., which was returned to service by use of inlet-end inserts at a saving of $30,000.



Before you scrap condenser tubes because of inlet-end leaks GET ALL THE FACTS

It sometimes happens that a combination of erosion and corrosion at the inlet ends of condenser tubes may seem to force their replacement. This is not always necessary. If the damage is confined to a small area at the inlets, and the tubes otherwise are in good condition, they can be saved by using inserts designed especially for just such circumstances. There are several makes available, none made by Revere.

In a recent case, involving a condenser of the Lynn Gas & Electric Company, Revere recommended inserts. Here are the figures: Number of tubes involved, 4,100; Replacement cost, $35,000; Cost of inserts to cure the trouble, $5,000; Saving, $30,000. Repairs should enable the condenser to serve for several more years. The work was so successful that a similar job was done on another Lynn condenser containing 2,700 tubes.

Of course Revere wants to sell condenser tubes, and its other products in copper and copper-base alloys, and aluminum, but we know that fast friends and loyal customers are won by taking to heart the best interests of those with whom we deal. May we have the privilege of working with you on condenser tube matters? Send for free booklet, "Life Extension for Condenser Tubes."

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

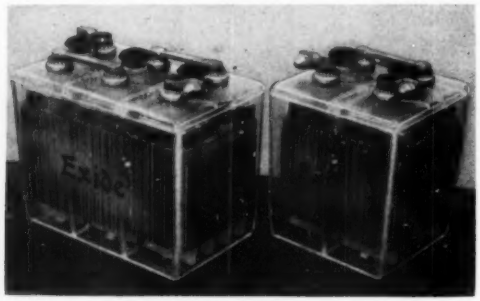
• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

More EQUIPMENT NEWS

Begins on page 154



PLASTIC CASE STORAGE BATTERY SHOWS STATE OF CHARGE

P730 • Series of storage batteries of two- and three-cell construction for stationary applications offers advantages in space and weight saving, maintenance and improved dependability. *Exide* Type PLX batteries are in transparent polystyrene plastic cases that show at a glance electrolyte level and approximate state of charge.

Markings on transparent case show recommended high and low electrolyte levels. Built into each outer cell is a chamber in which a red, a white, and a blue ball float in electrolyte when the battery is fully charged. When battery is 10% discharged the blue ball sinks. When it is 1/3 discharged the white ball sinks. When 2/3 discharged the red ball goes down.

The Electric Storage Battery Co, Box 8109, Philadelphia 1, Pa.

STAND-BY LIGHT

P744 • *Watchmaster* automatic stand-by light with glass jar rechargeable battery and visible ball float hydrometer supplies emergency light when fuses blow or power goes out. Built-in trickle charger maintains specific gravity between emergencies and built-in fast charger restores battery quickly for next emergency.

Choice of floodlight or sealed beam lamp, plus either condulet connection for permanent wiring or cord and plug attachment for portability. Lamp heads are removable for remote mounting.

The Carpenter Mfg Co, Boston 45, Mass.

WELDING FLUX

P713 • Equally effective as paste or powder, All-State No. 35 aluminum welding and stainless steel flux does not break down under high stainless welding temperatures or flake off and leave unprotected surfaces. It does, however, spread thinly and evenly, clean oxides ahead of the welding puddle and float off any impurities.

All-State Welding Alloys Co, Inc, White Plains, N. Y.

CHLORINIZER CONTROLLER

P745 • Simple, accurate device controls feed of chlorine at predetermined rates for predetermined periods in identical cycles. Employs cam-operated pressure valve that transmits varying pressures to the lower diaphragm pressure chamber of a chlorine control valve in the manufacturer's Chlorinizer. *Automatic Program Controller* operates from water or pneumatic pressure, can be easily installed, gives long service.

Builders-Providence, Inc, 345 Harris Ave, Providence 1, R.I.

TACHOMETER INDICATORS

P746 • Continuously indicating spread scale tachometers have 10 overlapping or adjoining ranges selected by rotary switch. Readings from 36 to 100,000 rpm are possible, and accuracy to ¼% is claimed. Instruments cannot be damaged by overspeeding, nor can dirt enter enclosed case. Calibration adjustment and voltage regulator are included in *Type 42H, 42J, and 42K* tachometer indicators.

Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

For more data on these items, use post cards, p 163. Identify request with P and number.

MOISTURE SEALER

P748 • Liquid chemical additive makes a fast-acting leak-stopper out of ordinary cement or cement and sand. With this product, *Flextite*, setting time for portland cement can be varied from 30 seconds to 30 hrs and direct leaks can be stopped without removing hydrostatic pressure. Ideal for sealing off leaks in elevator pits, engine rooms.

Flexrock Co, 36th and Filbert St, Philadelphia 4, Pa.

RUBBER-PHENOLIC LAMINATE

P749 • Specially formulated new rubber-phenolic varnish, 12359, permits manufacture of laminated plastics for service in gears, shuttles, tubing and castor wheels where high impact strength, great flexibility and toughness are required. Product may also permit phenolics to enter the paper-coating field.

Chemical News Bureau, General Electric Co, Pittsfield, Mass.

OIL-RESISTANT FILLER TAPE

P747 • Made of synthetic rubber, the oil-resistant *Scotch* brand electrical tape No. 25 gives rapid insulation build-up on splices in large power cables. Chemical resistant qualities, high dielectric strength and resistance to high temperatures make wide applications, such as mining, oil drilling and underground cable operations, possible. 40-mil thickness and extreme stretch (1500% breaking point) make tape suitable for smooth insulation wraps on all kinds of irregular surfaces.

Dielectric strength is 15,000 v unstretched and 10,000v at 500% elongation. It has an electroyltic corrosion factor of 1.0 and an insulation resistance of 100,000 ohms.

Tape is available in ¾-in. by 15-ft rolls, is green colored, and has a white strippable liner to be removed before using. It is not designed as a sole insulation, but recommended as the outer wrap for protection against moisture, weather and abrasive conditions.

Minnesota Mining & Mfg Co, 900 Fauquier St, St. Paul 6, Minn.

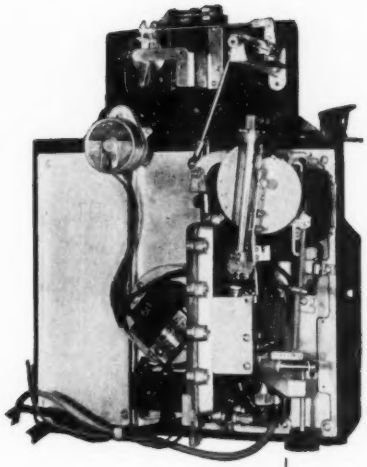
(*Continued on page* 168)

a new low differential flow meter to measure . . .

air flow

gas flow

or air flow-gas flow ratio



hays diaflow meter

The Hays Diaflow Meter is a *new* low differential flow meter for measuring air flow, gas flow or recording the ratio of air flow to gas flow. Especially adaptable for industrial furnaces and sewage disposal plants, the Diaflow meter is used as a guide in achieving product, process and cost control.

Employing the pilot method of operation the diaphragm measuring element will accommodate static pressures up to 10 lbs. and differential pressures up to 20" water. Write today for Bulletin 52-1017-37 containing complete information on the new Diaflow meter.

features

PILOT METHOD
provides higher sensitivity and greater accuracy . . . no load placed on measuring element.

DRY, DIAPHRAGM MEASURING
—no messy fluids . . . no leveling required.

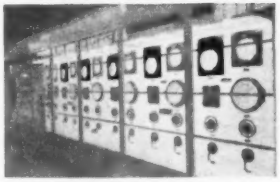
UNIT CONSTRUCTION
—easy parts removal without affecting calibration.

PIVOTED CONSTRUCTION
—internal parts accessible from front of case . . . no special tools required.

HIGHLY ADAPTABLE
—wide variety of models fit most measuring requirements.

DUAL FLOW
—gas and air flow records can be coordinated for efficient combustion.

applications



Industrial Furnaces—Diaflow measurement in open hearth, soaking pit, billet, slab heating and annealing furnace indicates excessive amounts of air and/or gas . . . helps to prevent fuel and gas waste . . . serves as a guide in maintaining product quality.

Sewage Disposal Plants—A guide to proper control of sewage treatment processes. Diaflow metering indicates: load on plant, variations in functions, relative rate of fluid flow and a continuing check on costs.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Ver-i-flow Meters and Ver-i-trol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders

THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

ionXchange

pioneers and leaders in ionXchange

ILLCO-WAY "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . and the development and building of the first successful installations for the purification of such liquids as beet-juice and crude glycerol by ionXchange . . . In the power field, boiler feed water treatment by ILLCO-WAY ionXchange has long meant lower operating costs and increased operating efficiency. Installations in leading plants.

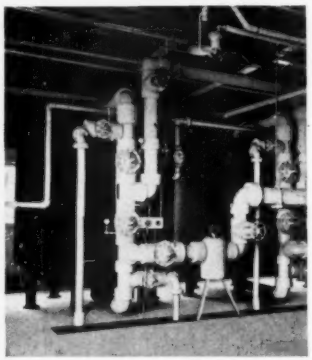
ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

For complete data, see Sweet's File, Power Plant

(Advertisement)

CASE HISTORY



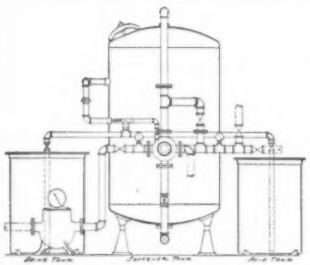
WESTERN ELECTRIC CO.

The above Illco-Way triplex softener, semi-automatically controlled, produces a peak of 60,000 gallons per hour of softened water for chemical operations associated with vacuum tube manufacturing and for boiler feed make-up at the Allentown, Pa. plant of Western Electric Co. Inc. Flow rate: 500 gpm for each of three softener units.

Water produced is free of hardness and scale-forming properties. Its use assures the water purity required for manufacturing operations and reduces chemical feed treatment of the boiler water and costly shut-downs for cleaning.

An Illco-Way softener was chosen for this installation because of the low-pressure boiler operation requirements and the low solids content of the raw water supply.

Illco-Way equipment, used in America's outstanding plants, includes the recently-developed Mixed-Bed De-ionizers, Hydrogen-Zeolite Units, Zeolite Softeners, Degasifiers, Filters.



ILLCO-TEMP SOFTENER

Illco-Way's hot-process (Zeolite softener) is designed for removal of residual hardness from the effluent of hot or cold lime-soda-units—without chemical after-treatment. The Illco-Temp Softener reduces, and in some instances eliminates, necessity of soda ash addition to the hot process units, thus decreasing operating costs, caustic alkalinity and CO_2 in return system. Easily added to lime-soda softeners, Illco-Temp Softeners operate economically and continuously at temperatures of 250° F. and above.

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

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7/52

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☐ NEW PRODUCT ☐ ADVERTISEMENT ☐ LITERATURE

_____
Describe item here
_____

It appeared on page_____of the_____Issue of POWER.

My Name.....
Please print
Title.....
Company.....
Street Address.....
City, State.....

This month's FREE Literature

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **FILTERS**—For ventilation and air conditioning equipment. 8-page bulletin 100 gives photos, specifications on viscous, washable *Staynew* filters. Dollinger Corp, 11 Centre Park, Rochester 3, N. Y.

B2 **UNIT HEATER MAINTENANCE** — For steam and hot water units. 4-page bulletin No. 12 gives installation essentials and maintenance procedure. Industrial Unit Heater Assn, 2159 Guardian Bldg, Detroit 26, Mich.

B3 **PORTABLE HEATERS**—Up to 139,000 Btu per hr; can be converted to 1500 cfm cool air circulators for summer. 6-page bulletin L-5391 gives photos, construction. Vageol Heat Machine Co, 5725 Mt Elliott Ave, Detroit 11, Mich.

B4 **AIR COOLING UNITS**—For cold storage, chilling and processing rooms, etc. 8-page bulletin No. 185-F has installation photos, dimensions. Frick Co, Waynesboro, Pa.

BOILERS AND AUXILIARIES

B5 **UNIT STEAM GENERATOR**—400 to 20,700 lb per hr at 312 F, oil or gas firing, staggered tubes, 4-pass construction. 28-page bulletin 2000 gives dimensions, components. Preferred Utilities Mfg Corp, 1260 Broadway, New York 22, N. Y.

B6 **BENT TUBE BOILERS**—14-page bulletin gives data on 10 installations of VP and VS boilers. Drawings, photos. Henry Vogt Machine Co, Inc, 1000 W Ormsby, Louisville 10, Ky.

B7 **STEAM GENERATOR**—*Amesteam* unit. 845 to 17,250 lb per hr. 8-page bulletin 1050 describes construction, auxiliaries, typical boiler room layout. Ames Iron Works, Box R-1, Oswego, N. Y.

B8 **DUST COLLECTORS**—Low draft-loss units. Type P for stoker-fired boilers, type S for losses under 0.2 in. water, type V for lightweight or fine dusts. 8-page booklet. Buhar Dust Systems, Inc, Old Lyme, Conn.

B9 **SMOKELESS FUEL PRODUCER**—*Stilcoh* process distills bituminous coals, lignites, etc., to recover oils and gases, produce smokeless coke. 16-page bulletin describes apparatus, process and plant layout, outlines previous methods of coke-making. Stilcoh Co, 1260 N Mar Vista Ave, Pasadena, Calif.

ELECTRICAL EQUIPMENT

B10 **SQUIRREL-CAGE INDUCTION MOTOR**—Drip- and splash-proof types AW and AWW. Ratings from 15 hp at 450 rpm to 800 hp at 3600 rpm. 6-page bulletin 51B7693 shows construction, photos. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B11 **CIRCUIT BREAKERS**—*DE-Ion* arc-quenching, type AB units. 36-page booklet B-5407 gives types, ratings, standard and special features. Photos, operation and selection data. Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

B12 **ELECTRICAL MAINTENANCE** — 24-page booklet B-4746 presents complete maintenance program based on renewal parts, repair service, field service. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B13 **SOLDERLESS POWER TERMINALS**—Also connectors. Wire sizes from No. 16 to 4/0. 16-page catalog gives descriptions, photos, tables. Aircraft-Marine Products, Inc, 2100 Paxton St, Harrisburg, Pa.

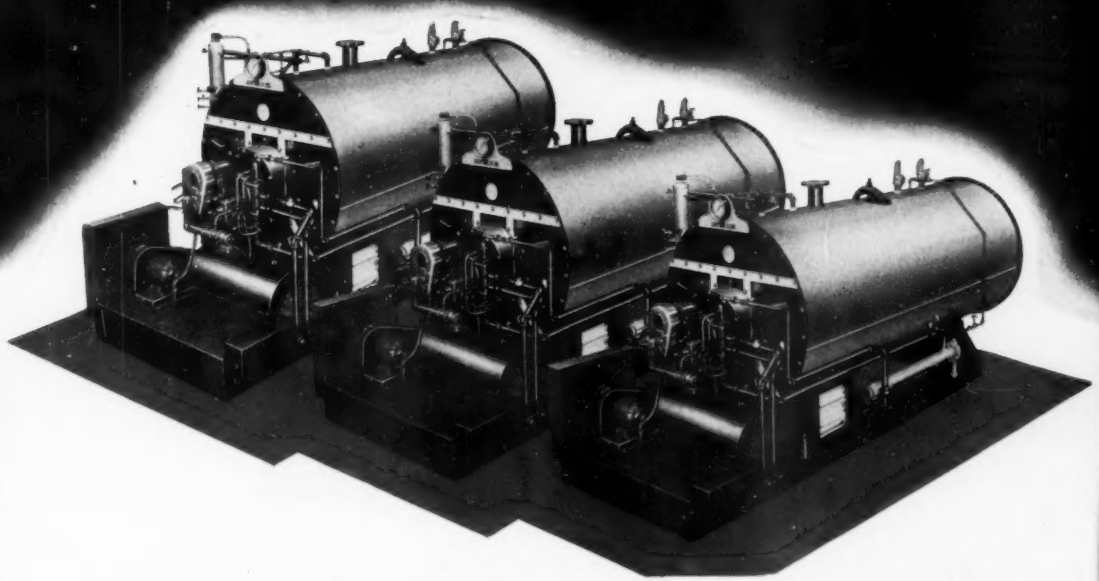
B14 **ELECTRICAL INSULATION**—For manufacturing, rebuilding, and maintenance. Tapes, insulating papers, phenol fibres, tubings, mica and silicone products, etc. 96-page catalog gives properties, prices. Brownell Distributors, Inc, 308 Canal St, New York 13, N. Y.

B15 **THERMISTORS**—Electronic semi-conductor control elements, rod, disc and washer types. 20-page catalog TH-5 gives descriptions, characteristics, wiring diagrams. Carboloy Dept, General Electric Co, Detroit 32, Mich.

(Continued on page 210)

1+1+1=7

WHEN YOU'RE COUNTING *Superior* STEAM GENERATORS



Battery installations of Superior Steam Generators provide extreme flexibility to meet the most widely fluctuating steam demands. A hospital installation illustrates the point.

From early June through September, steam demand is limited to the needs of hot water and sterilization. Any one of the three units carries this load with ease . . . and at higher efficiency than could be obtained by minimum operation of a larger boiler.

When cold weather adds its heating load, a second Superior Steam Generator is fired. Only the most severe weather demands firing the third unit . . . which throughout the rest of the year provides stand-by equipment which is desirable in any operation.

By employing different combinations of the three, (7 in all) allowing each unit in turn to share the load; all enjoy longer life at maximum efficiency . . . and by using only the number dictated by the steam demand, maximum economy at every stage of steam demand is assured.

Let us show you how battery installation can serve you better in your new plant . . . or augment your present steam facilities.

Write today for Catalog 401

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

Photo by Ewing Galloway

Radar New? Not to a Bat!

HERE'S NATURE'S RADAR. To survive in his environment of dark caves and night flying for food, the bat has developed a high-frequency radar-like system. You can see how it works from these highly developed double ears.

He emits sharp cries while flying blind. Calls inaudible to the human ear bounce back from obstructions ahead. And they are immediately picked up by the delicate "receivers," to guide him.

With wires stretched across the cave entrance at night, he flies in and out without touching them, even when blindfolded. But with ears plugged, he can't even find the entrance.

The bat has survived because he adapted himself to conditions he had to meet. That's more than many engineers and plant owners can say. About the time some older operators settled down in their cane bottomed chairs alongside the old corliss, the steam turbine and the diesel engine came along. Now the gas turbine and atomic power are peeking around the corner.

But some engineers stubbornly hang on to obsolete equipment. What's worse, also to old ideas! All of which reminds me of something that grand old man of General Motors Corp, Boss Kettering, once said, "NOTHING IS CONSTANT BUT CHANGE."

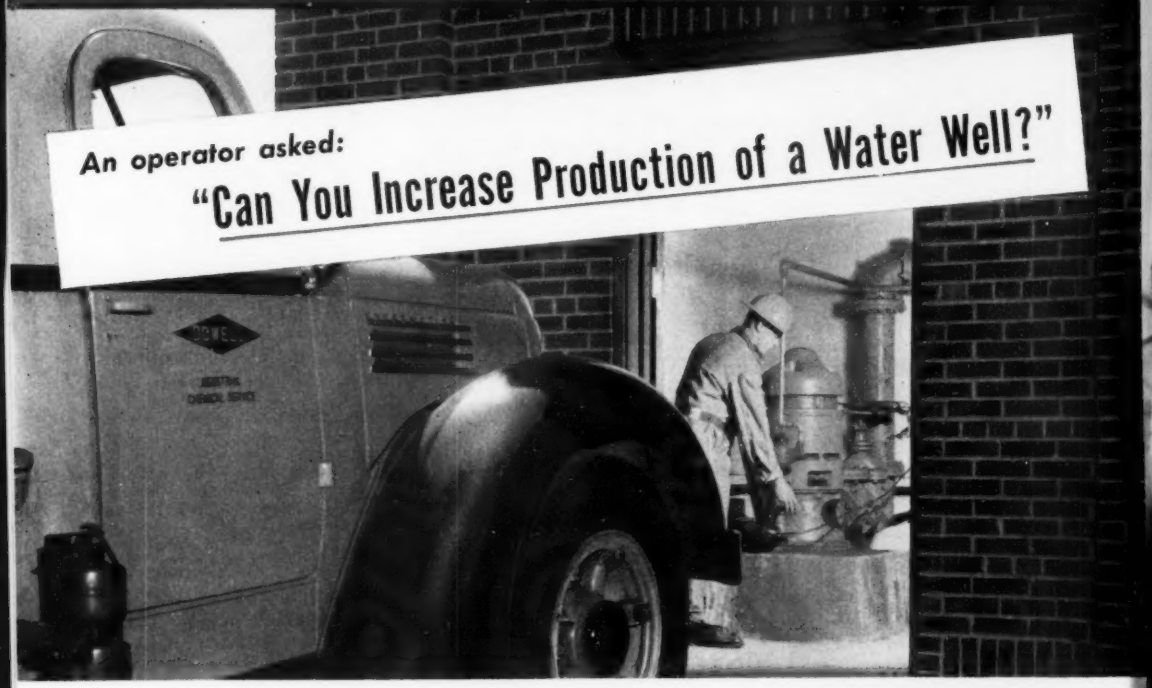
Let's think that over before we get too satisfied with our plant. And if a dumb bat can keep in step to survive, there's no reason why we engineers can't do the same. That means taking advantage of every new development to give us more power at less cost.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



An operator asked:

"Can You Increase Production of a Water Well?"

Dowell Service increased production of the well by 900%

Production of a city water well had dropped to 87 gallons per minute at 40 ft. drawdown. Dowell engineers were called. Their chemical treatment of the well jumped production to 800 g.p.m. at 11 ft. drawdown. Such results are not unusual after Dowell Service.

Pulling of the pump or replacing the screen is seldom necessary. Special chemicals are pumped into the well to remove scale and corrosion products from the screen, pump, tubing and face of the producing formation. Production may also be increased due to enlargement of the water passages in the formation itself.

Dowell furnishes all necessary chemicals, trained personnel, pump trucks and controls. Inhibitors protect well equipment from metal loss during the treatment. In wells producing water for domestic and commercial consumption, tasteless, odorless, non-toxic inhibitors are used.

Savings in time and money through Dowell Service are not confined to water wells alone—boilers, heat exchange equipment, processing equipment and water lines have been cleaned better, faster and more economically. Contact the Dowell office located near you for a free estimate on solving your problems.

Other recent Dowell jobs:

A power company's evaporators, in use for five years, were cleaned by Dowell Service in just 9 hours.

•

Dowell successfully cleaned a front gas seal of a blast furnace. This eliminated the necessity for taking the furnace out of service.

•

The water in an overhead box condenser was actually boiling because deposits retarded heat transfer. Cleaning by Dowell lowered product temperature from 190° F. to 160° F. without requiring shut down of the condenser or still.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Ft. Worth 2	Atlanta	Mt. Pleasant, Mich.
Boston 16	Chicago 4	Indianapolis	Hamilton, Ohio
Baltimore	St. Louis 8	Louisville	Charleston, W. Va.
Wilmington 99	Kansas City 8	Upper Montclair, N. J.	Salem, Illinois
Richmond 19	Wichita 2	Ardmore, Pa.	Beaumont, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Borger, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Midland, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Wichita Falls, Texas
Pittsburgh 19	Shreveport 69	Dearborn, Mich.	Hobbs, N. Mex.

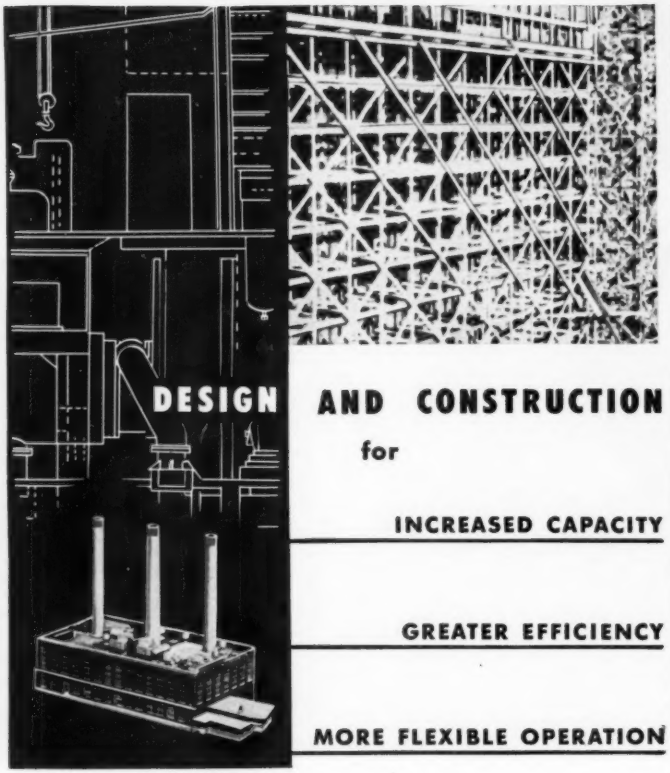
★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY



Bayboro Power Plant, Florida Power Corporation, St. Petersburg, Fla.

Increasing population and great industrial growth demanded rapid expansion of Florida Power Corporation's Bayboro Plant. The solution of this urgent power problem is an excellent example of how creative engineering surmounts the obstacles met in modern expansion projects.

Making maximum use of existing facilities, The Kuljian Corporation's *design* provided needed additional capacity with increased over-all efficiency and greater control flexibility.

Construction was completed by The Kuljian Corporation on a seemingly impossible schedule to permit tie-in to existing equipment during a low-demand period.

The Kuljian Corporation's experience in solving many power generation and utilization problems can help you win your race against time . . . profitably.

The **Kuljian** *Corporation*

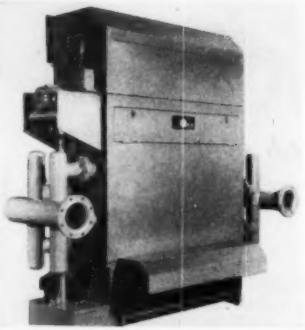
ENGINEERS • CONSTRUCTORS

1200 North Broad Street, Philadelphia 21, Pa.

MEXICO CITY • CARACAS • MADRID • ROME • ATHENS • TOKYO • CALCUTTA

More EQUIPMENT NEWS

Begins on page 154



AIR AND GAS AFTERCOOLER

P706 • *Aero* aftercooler, suitable for compressed air or gases, has 25 to 75% more capacity than previous models manufactured by this firm. Cooling is done by evaporation of recirculating water sprays. Unit consumes less than 5% of the cooling water needed by conventional aftercoolers.
Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

PLUG-IN ALARM ANNUNCIATORS IN HERMETICALLY SEALED UNITS

P727 • *Tel-Alarm*, automatic alarm units for remote signalling of failure or other-than-normal operation of valves, pumps, heaters. These alarms are of unitized construction and permit a variety of circuit arrangements from one basic alarm unit.

Units are self-contained and plug in to chassis as easily as a vacuum tube. Chassis is also standard, varying only in size to accommodate various multiples of *Tel-Alarm* units.
Anderson Co, 4332 N Western Ave, Chicago, Ill.

For more data on these items, use post cards, p 163. Identify request with P and number.

HIGH-CURRENT RESISTOR

P725 • *Powr-Rib*, a new edgewound-type resistor, is designed for high-current duty in both intermittent and continuous applications. Resistor offers high heat dissipation, resistance to oxidation, and ability to withstand shock and vibration without breaking or shorting.

Resistors are suitable for original equipment or for replacement in existing in-

Simplify Valve Inventories!

These "RENEWO" Valves Convert From Fullway To Plug Type!

Lunkenheimer "Renewo" Valves feature renewable and regrindable seats and discs . . . convertible from fullway to plug type. Stockroom investment and maintenance expense can be cut substantially by users who standardize on the line for all their 200-lb. bronze globe valve needs. A similar line is also available in the 300-lb. class.

"Renewo" Valves can be reground, renewed, or converted easily.

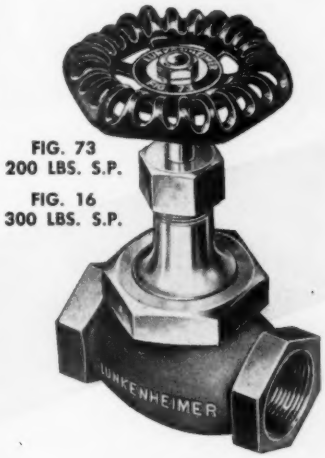


FIG. 73
200 LBS. S.P.

FIG. 16
300 LBS. S.P.

(FULLWAY TYPE) Seats and discs of hard, wear-resistant nickel alloy. Excellent for general service applications. One of the most popular valves ever designed.

FIG. 73 PS
200 LBS. S.P.

FIG. 16 PS
300 LBS. S.P.

(PLUG TYPE) Seats and discs of 500 Brinell Stainless Steel. Superior for severe erosive applications. Maximum resistance to effects of close throttling.

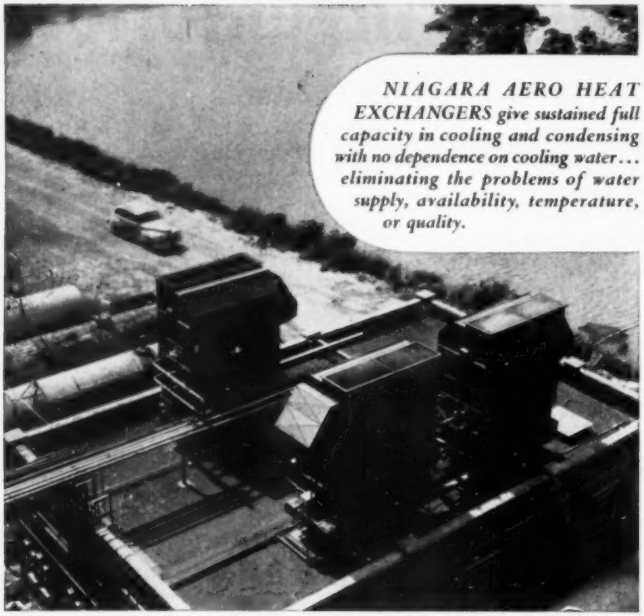
WRITE FOR Circular 577, which describes the "Renewo" line in detail. The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-952-5


NIAGARA AERO HEAT EXCHANGERS give sustained full capacity in cooling and condensing with no dependence on cooling water... eliminating the problems of water supply, availability, temperature, or quality.

Niagara Aero Heat Exchangers at a Plant of the Heyden Chemical Corp.

Still Operations Improved by a New Cooling Method

• NIAGARA AERO HEAT EXCHANGERS cool the reflux supply or condense vapors at a vacuum by controlled evaporation of water directly on the heat exchange surfaces.

Liquid or vapor temperatures are always held constant by the Niagara "Balanced Wet Bulb" control method, which automatically varies the cooling effect proportionately to the load. The distillation is therefore uniform throughout all changes in climatic conditions the year around; it is the same in the heat of summer as in the freezing cold of winter. Continuous maximum production is thus insured.

Non-condensibles are effectively separated at the condensate outlet, with notable sub-cooling after separation for greater vacuum pump efficiency.

Use of Niagara Aero Heat Exchangers reduces your operating costs and removes many sources of your troubles in distillation column operation. Ask for new bulletin #120.

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave. **New York 17, N. Y.**

Experienced District Engineers in all Principal Cities of U. S. and Canada

More EQUIPMENT NEWS

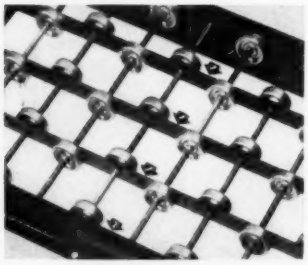
Begins on page 154

stallations where high-current and good heat-dissipating characteristics are required. They are particularly applicable in motor controllers, load banks, plating and welding equipment, as well as motor starting, plugging, field discharge, and dynamic braking in dc controllers.

Available in values from 0.100 to 2.85 ohms. They are rated at 375 C (707 F) temperature rise (NEMA standard) on the ribbon. Full-rated capacities range from 18.0 to 108 amperes. Bulletin No. 141 available upon request.

Ohmite Mfg Co, 4823 Flournoy St, Chicago, Ill.

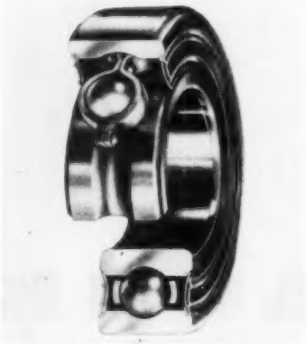
For more data on these items, use post cards, p 163. Identify request with P and number.



GRAVITY CONVEYOR

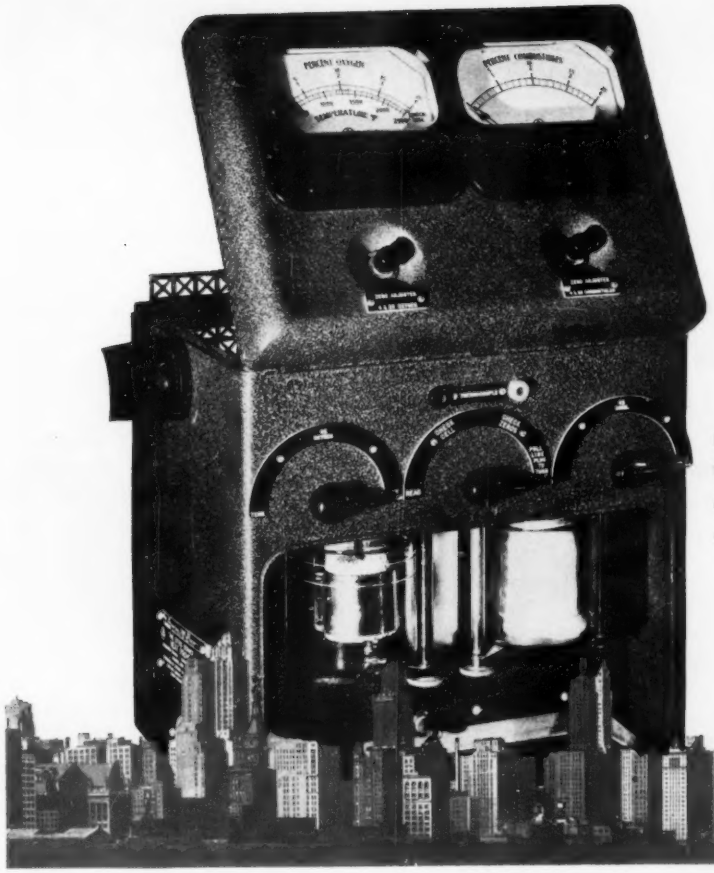
P715 • Industrial gravity conveyor, the *Rapid-Wheel*, has 3½ in. deep channel frames of 12-gage steel; comes in 5 and 10 ft sections, 12 and 18 in. wide and also in 45 and 90-degree curves. It combines the advantages of a conventional wheel gravity conveyor with the added benefits of extra rugged construction and increased capacity.

The Rapids-Standard Co, Inc, Dept IRS, 342 Rapistan Bldg, Grand Rapids 2, Mich.



SEALED BALL BEARING

P731 • Bearing is designed to keep dirt out and lubricant in. It is interchangeable with conventional non-sealed bearings.



FROM THE TOP STEEL PRODUCER . . .
TO A LEADING CHEMICAL HOUSE,
A YEAST COMPANY
AND A MEAT PACKER . . .

Heat Prover SERVES 62 DIFFERENT COMPANIES IN THE GREAT CHICAGO INDUSTRIAL AREA!

The Cities Service Heat Prover is graphically proving its worth to all kinds of industry in the Chicago area and elsewhere throughout the country.

62 different companies, producing everything from steel to beef, have found the Heat Prover an important aid to increased production and big dollar economy.

WHEREVER A FURNACE OPERATION IS INVOLVED, Heat Prover can help increase productivity by providing:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

REMEMBER: Heat Prover is not an instrument you buy but a service we supply. Contact the Cities Service office in your area and learn how Heat Prover can serve you . . . or write CITIES SERVICE OIL COMPANY, Dept. G 22, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Deming "MOTOR-MOUNT" Condensation Return Units (above and at right). Single and Duplex units for 2,000 to 40,000 sq. ft. of radiation.

Deming Fig. 4958 Centrifugal Jet Units (below) for 500 to 10,000 sq. ft. of radiation.

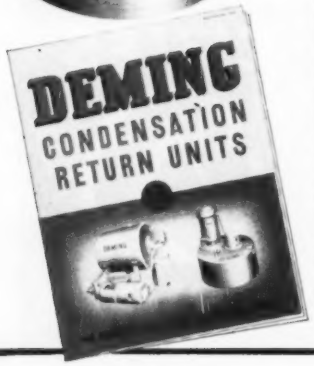
● These modern, efficient "fuel-savers" return the condensate from steam coils, radiators, or steam operated equipment back to the boiler.

Deming "Motor-Mount" centrifugal pumps are used on Deming "Motor-Mount" Condensation Return Units. Pump motors have standard "NEMA" type "C" mounting flange and are furnished for single phase, two or three phase or for direct current, as specified.

"Motor-Mount" pumps are equipped with enclosed type bronze impeller and stainless steel pump shaft. Deep stuffing box is provided with conventional packing rings for grease lubrication.

Deming Fig. 4958 "Hotshot" Condensation Return Units are equipped with a centrifugal jet pump. Entire pumping unit and jet can be removed for cleaning without disturbing any of the piping.

Ask your Deming Distributor or write us for illustrated Bulletin No. 4400 which includes performance tables to simplify selection of proper unit to meet specific requirements.



THE DEMING COMPANY
547 Broadway • Salem, Ohio

More EQUIPMENT NEWS

Begins on page 154

Seal is made of stable DuPont *Fairprene* and is not affected by petroleum-base lubricants, normal operating temperatures, or aging.

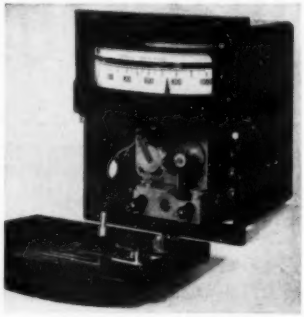
Effective sealing—with extremely light contact and low friction—is provided by extending seal below steel retaining ring. This forms a flexible lip that lightly touches a smooth, uniform chamfer of inner ring. **SKF Industries, Inc, Philadelphia 32, Pa.**

For more data on these items, use post cards, p 163. Identify request with P and number.

CINDER CRUSHER

P751 • Special 3-roll cinder crusher speeds up job of crushing boiler furnace cinders to a suitable size for quick disposal to concrete block plants. It produces 15 tons of $-\frac{3}{8}$-in. and up to 50 tons of $-\frac{3}{4}$-in. cinders per hr, handling entering pieces up to 6 in. A large hopper and enclosed rolls prevent spillage, and direct material to crushing rolls. There are designs for permanent mounting or portable service.

Eagle Iron Works, 129 Holcomb Ave, Des Moines, Iowa



TEMPERATURE CONTROL

P732 • Instrument for close control of electrically heated or fuel-fired industrial process equipment. *Pyr-O-Vane* controller is a time-proportioning indicating millivoltmeter controller for use on small heat

Here's all it takes...

OUR 60TH ANNIVERSARY

for Easy–Safe–Sure
Remote Valve Operation

LimiTorque valve operation is the ultimate in ease and simplicity . . . just the pressure of a finger and LimiTorque will open and close valves up to 120" diameter.

Think of the savings effected in time and money by eliminating men going from one valve to another, many of which are at distant locations—not to mention the time required to shut or open each valve. *LimiTorque Remote Control* not only prevents this waste, but enables one man to operate all valves from a central location and actually see on a panelboard whether the valves are open or closed.

Various types are available for different requirements on all makes of valves: globe, gate, butterfly, plug, etc. *LimiTorque* may be actuated by any power source, such as electricity, water, gas, oil or air. Your valve manufacturer can supply LimiTorque Controls.

LIMITORQUE®

For details, send for our 96-page catalog, L-50.

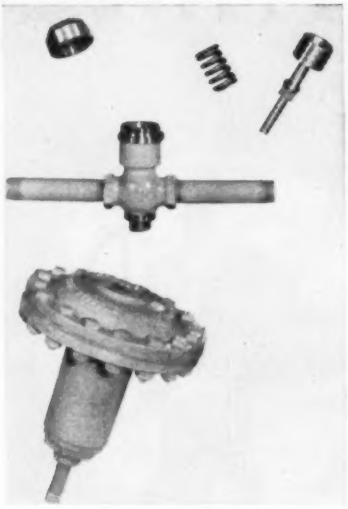
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

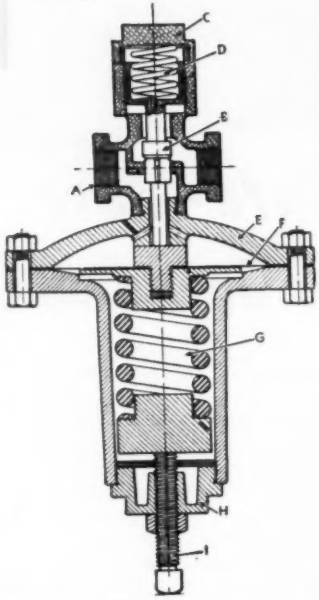
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Simplify Valve Maintenance!



Specify Stickle Reducing Valves. Re-grind the Valve—Replace the Diaphragm —*Without Tearing Down The Line!*

No need to tear down the line to inspect or service this Stickle Spring Balanced Reducing Valve! You can get at any individual part *without removing valve body from the line.* Valve is *not* attached to diaphragm—can be separated easily. Entire diaphragm case is also quickly detachable. (See exploded view, at left.)



APPLICATION

Stickle Spring Balanced Reducing Valves are available in three sizes—½", ¾", and 1". Each proves exceptionally satisfactory for any standard service on water, steam, or air. *Results are guaranteed* in advance of installation, on a full, money-back basis.

OPERATION

Reduced pressure is connected to "A" and is in direct contact downward with diaphragm "F" through internal port, thereby keeping diaphragm water sealed at all times. Spring "D," plus initial pressure on top of valve, assures positive closing against dead end. Tension in spring "G" is changed by set-screw "I" at bottom, to obtain variation in pressure reduction. For additional facts, send for free bulletin, below.

STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

FREE! *Get all the illustrated facts about cost-cutting Stickle Valves. Send for Bulletins 235, 255, and 435. No obligation, of course!*

More EQUIPMENT NEWS

Begins on page 154

treating furnaces, plastic extruders, nylon heat setting equipment.

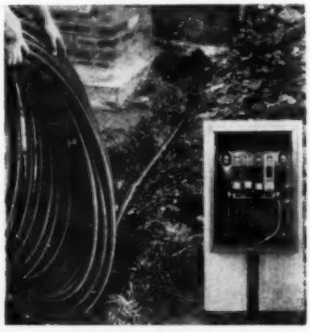
It is designed to provide straight-line control where rapid heating rates, small heating capacity or abnormal process lags are encountered. Gears supplied with each instrument provide a choice of six cycle-times to meet varied process requirements. **Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Aves, Philadelphia 44, Pa.**

For more data on these items, use post cards, p 163. Identify request with P and number.

LABELING TAPE

P710 • You can write on this pressure-sensitive tape. Label is waterproof, oil-proof, smudgeproof and is available in four colors, seven widths and two roll lengths. *Labelon* has long life and many industrial uses like machinery and parts identification, warranty dating, special circuit labeling, etc.

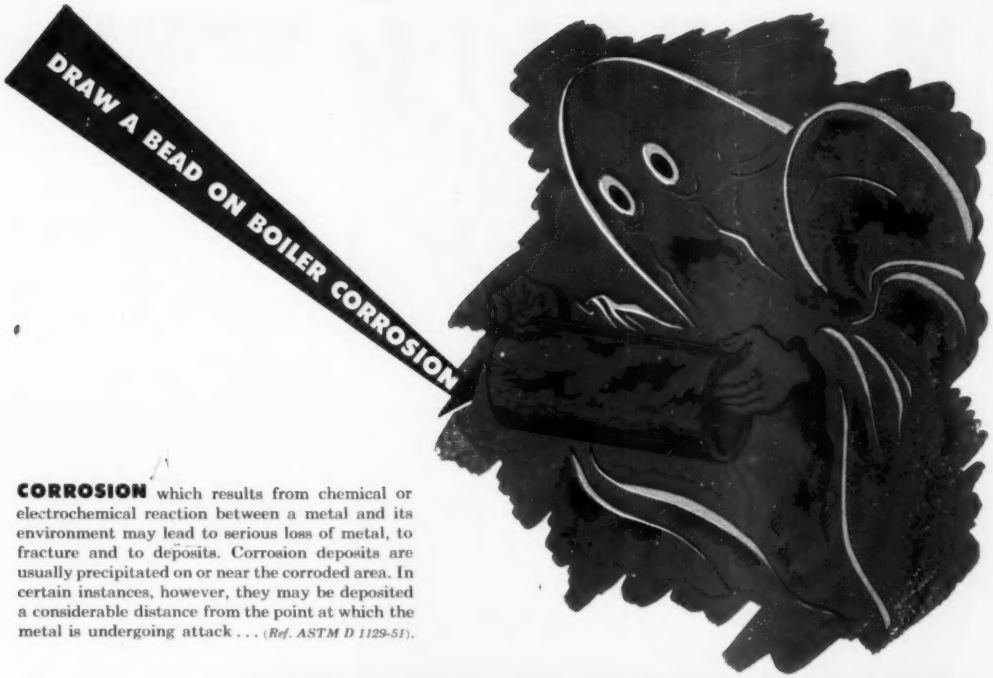
Labelon Tape Co, 450 Atlantic Ave, Rochester 9, N. Y.



PLASTIC CONDUIT

P729 • Flexible plastic pipe encloses and protects electrical wiring. It is a good insulator—dielectric strength is 500 volts per mil—can be installed with a minimum of time and expense, and offers dependable protection for many years.

Carlon plastic pipe is flexible, can be



CORROSION which results from chemical or electrochemical reaction between a metal and its environment may lead to serious loss of metal, to fracture and to deposits. Corrosion deposits are usually precipitated on or near the corroded area. In certain instances, however, they may be deposited a considerable distance from the point at which the metal is undergoing attack . . . (*Ref. ASTM D 1129-51*).

Use DREW POWER CHEMICALS

Corrosion may be active in your boiler water system now—ready to cause expensive trouble in boilers, steam and condensate lines. Serious deposits may result from corrosion. It's time now to inspect your boiler system thoroughly, to avoid inconvenience—even plant shutdown.

So, draw a bead on boiler system corrosion, Mr. Engineer. Call for the Drew Power Chemicals Engineer. The water samples and operating data he obtains in your plant will be thoroughly analyzed in the Drew Laboratories. You'll be given specific recommendations for corrective or preventive treatment. Furthermore, your Drew Engineer will give you frequent and continuous help in your plant.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew Engineer, or write for information.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

AJAX, ONTARIO
SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS

Service throughout the United States, Canada and South America

DREW PRODUCTS

MAGNOLIA

Die-Cast

BEARING BRONZE BARS

A DEPENDABLE SOURCE OF SUPPLY—
Your Magnolia Distributor

Look to your Magnolia Distributor for a dependable localized source of service and supply for all your bronze bearing metal requirements. Backed by Magnolia's years of experience and research, your Magnolia Distributor can be a big help during these difficult days of shortages and high production requirements.

Write for your free copy of Magnolia's Size and Weight Charts.

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SOLD THROUGH INDUSTRIAL DISTRIBUTORS EVERYWHERE

MAGNOLIA METAL COMPANY

21 West Jersey Street • Elizabeth, New Jersey

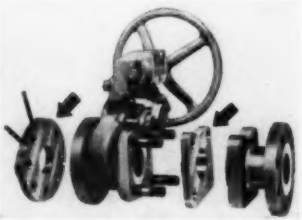
More EQUIPMENT NEWS

Begins on page 154

curved to follow irregular surface contours, and structural plans. It can be bent cold and fastened to building framework. Supplied in lengths to 400 ft, it requires minimum number of fittings. *Carlon* is extremely light, weighing only 1/9 as much as steel of comparable diameter. It can be handled easily by one man.

Carlon Products Corp, 10225 Meech Ave, Cleveland 5, Ohio.

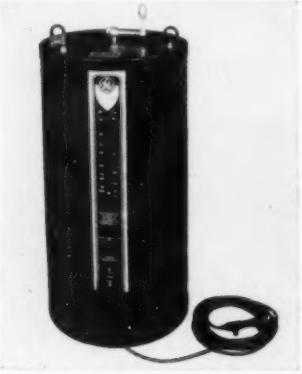
For more data on these items, use post cards, p 163. Identify request with P and number.



ELECTRICALLY-HEATED VALVES

P704 • Heated valves, 2 to 6 in., with pneumatic, hydraulic, solenoid or manual control are available with either 110- or 220-v heating elements. Input ranges from 400 to 3000 w per heating unit. Temperatures as low as —110 F can be carried in lines fitted with these valves without danger of valve mechanism freezing.

Okadee Co, 332 S Michigan Ave, Chicago 4, Ill.



ATOMIC-HYDROGEN WELDER

P752 • Redesigned atomic-hydrogen transformer welder incorporates a new hot-start circuit, silicone insulation, and an extra-wide current range (10 to 100 amp) that allows use of one machine on all applications. The range is divided into two sections, 10 to 35 and 35 to 100 amp, each extending full length of indicator scale. This allows precise current settings.

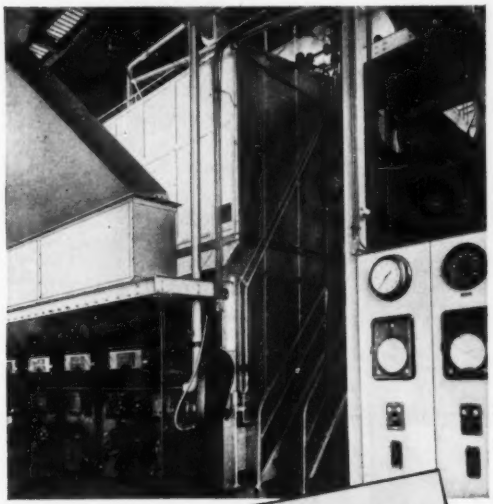
Unit includes power factor correction capacitors, portable start-stop pushbutton,

"HOW WE SAVE MORE THAN $90,000 A YEAR—

BY BURNING COAL THE MODERN WAY!"

says W. H. FISHER, Plant Engineer, Kerr Bleaching and Finishing Works, Concord, North Carolina.

"Powering our plant used to take nine boilers—now *one* does the same job *using 30% less fuel!* 6 firemen now do the work of 18—thanks to modern coal-handling equipment and automatic controls. That's why we say, you can't beat bituminous coal burned with modern equipment."



Above is a view of the plant's modern, space-saving coal-storage silo. To the left is a close-up of the firing aisle, showing the spreader stoker and the main control panel. Coal handling is automatic and dust-tight throughout. Automatic controls regulate firing, drafts and feed-water—give maximum efficiency at lowest cost.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U. S. A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

Burning coal the modern way can save *you* money, too! First, labor costs can be cut to a minimum with up-to-date coal- and ash-handling equipment. On top of that, today's combustion installations give you 10 to 40% more power from each ton of coal than was possible a few years ago!

If you're planning to modernize, or if you're building a new plant, call in a consulting engineer. He'll show you how you can get big savings by burning coal in a modern plant designed to meet your *specific* needs.

America's coal reserves are virtually inexhaustible; America's coal industry is the world's most productive and efficient. That's why coal has a future dependability of supply that no other fuel can offer. That's why, of all fuels, the price of coal is most likely to remain stable.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY ★ *FOR LOW COST*

YOU CAN COUNT ON COAL!

an ACCO product

PRESSURE Seals It!

• This R-P&C Valve has an inside bonnet which is forced tightly against a special metal sealing ring by the pressure in the valve. It stays tight under conditions of varying pressure, and the compensating wedge makes it easy to open and close. Also made as a globe valve.

Designed for high pressure, high temperature service. Cast steel construction. Sizes from 2½" to 12"; pressures to 1500 lbs.; temperatures to 1100° F.

For further information, see your R-P&C distributor or write the nearest R-P&C district office.

ACCO
TRADE MARK
R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver
Detroit, Houston, New York, Philadelphia, Pittsburgh,
San Francisco, Bridgeport, Conn.

R-P&C valves

More EQUIPMENT NEWS

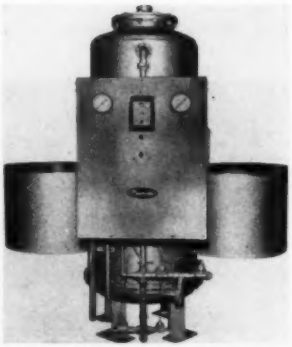
Begins on page 154

automatic gas shutoff and stepless current control.

Welder operates on 60-cycle single-phase voltage with a 75 amp rating. It is 41½ in. high, 18¾ in. in diameter and weighs 350 lb.

General Electric Co, Schenectady 5, N.Y.

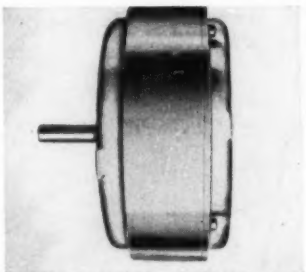
For more data on these items, use post cards, p 163. Identify request with P and number.



MONO-BED DEMINERALIZER

P714 • Completely automatic, supervision-free *Mono-Bed* demineralizer, available in flow rate capacities from a few gallons per hr to 5000 and up, requires no steam power; provides an effluent with a mineral content of virtually zero (resistances as high as 20,000,000 ohms per cm). When effluent conductivity falls below standard, treated water is discharged and warning lights go on. A flick of a switch puts the unit through its regeneration cycle automatically.

Penfield Mfg Co, Inc, 19 High School Ave, Meriden, Conn.

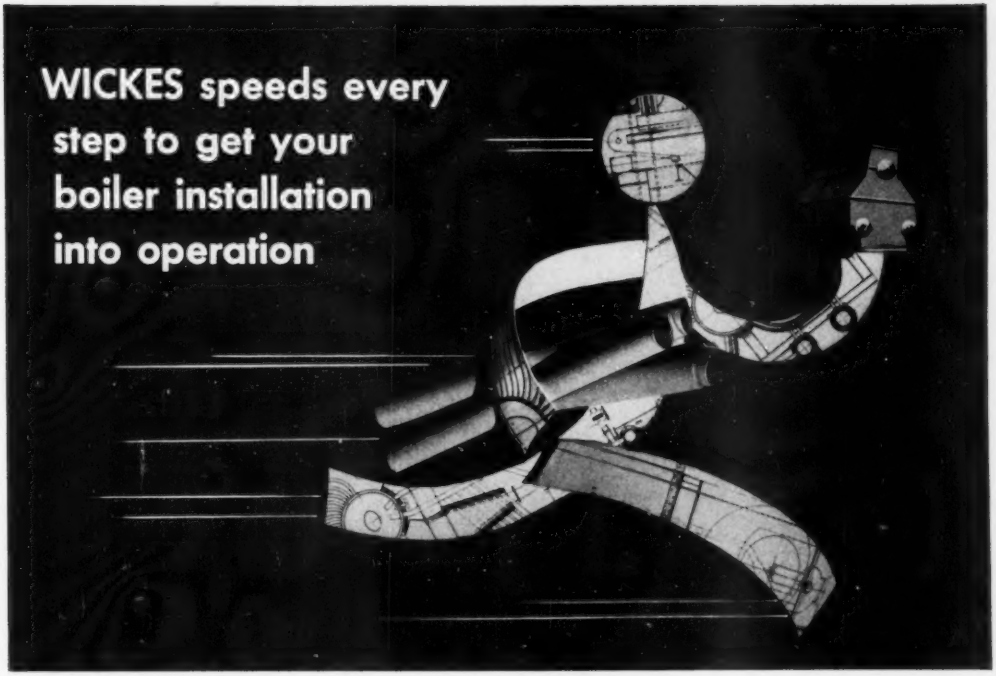


SMALL MOTOR

P753 • *Water* motor features an exceptionally short overall length. Well suited to applications requiring a totally enclosed, air cooled unit with a flat design. Available in ratings from 1/20th through 5 hp and in speeds from 450 to 3,600 rpm, single- or polyphase.

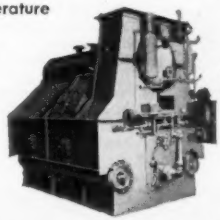
For ventilating and air moving installations the motor is mounted within piping

WICKES speeds every step to get your boiler installation into operation



From the moment you place your order for a Wickes boiler, Wickes engineers and production men swing into action. They know that when you want a new steam generator, you want it fast and they rush production to get it to you. Wickes does the whole job, too—from the time the first drawings are made right up to the day you raise steam pressure. They build the boiler and they handle every last detail of installation. Then Wickes service takes over and continues for the life of the boiler. Wickes sales engineers and maintenance men in most principal cities are ready to serve you day or night.

Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing. Wickes boilers operate at a high degree of efficiency and owners' records show modest maintenance costs. Write today for descriptive literature or consult your nearest Wickes representative.



WICKES

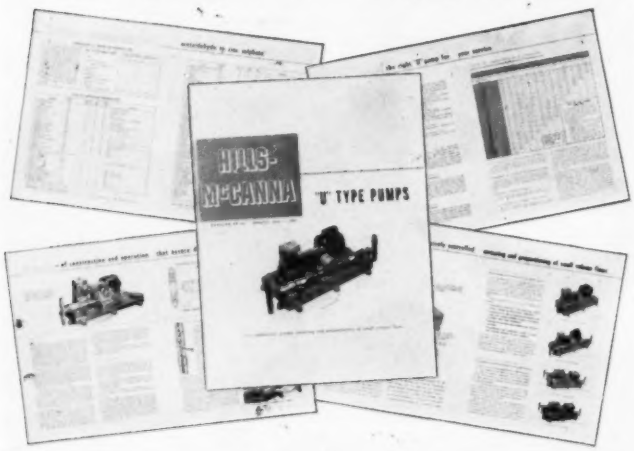
140

THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

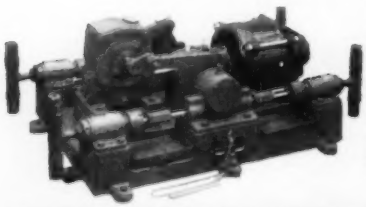
RECOGNIZED QUALITY SINCE 1854 **• SALES OFFICES:** Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N. C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

Here's a handy guide to the selection of metering and proportioning pumps



In this new catalog and pump selection manual for Hills-McCanna "U" Type Metering and Proportioning Pumps is all the information, including prices, for the selection of exactly the right pump for handling over 300 substances. Clearly and concisely, this helpful booklet gives all the necessary information and specific recommendations to cover the vast majority of needs that can be filled with a Hills-McCanna "U" Type Pump.

If your operations involve the metering or proportioning of small volume flows, you will find this catalog a useful addition to your files. We will be pleased to send you a copy on request. HILLS-McCANNA COMPANY, 2369 W. Nelson St., Chicago 18, Illinois.



Hills-McCanna "U" Type Pumps are reciprocating, variable stroke, mechanical drive units with maximum capacities ranging from 0.10 to 24 gph. per feed. One, two, three and four feed assemblies are available. Operating pressures up to 5,000 psi. A four feed unit is shown at the left.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of: Saunders Patent Diaphragm Valves Force Feed Lubricators • Magnesium Alloy Sand Castings

More EQUIPMENT NEWS

Begins on page 154

or vent. Frame design permits mounting (1) by means of "ears," (2) by drilled and tapped holes in endbells, or (3) by any other special requirement of the user. *Wafer* motors are quiet running and are available in a wide number of frame sizes.
Reuland Electric Co, Alhambra, Calif.

For more data on these items, use post cards, p 163. Identify request with P and number.

MASONRY WATER REPELLENT

P754 • *Ranetite No. 11* is a silicone-base water repellent for above-grade masonry. It is clear and invisible, can be sprayed or brushed on. It can be painted with oil-base paints.
Ranetite Mfg Co, 1917 S Broadway, St. Louis 4, Mo.

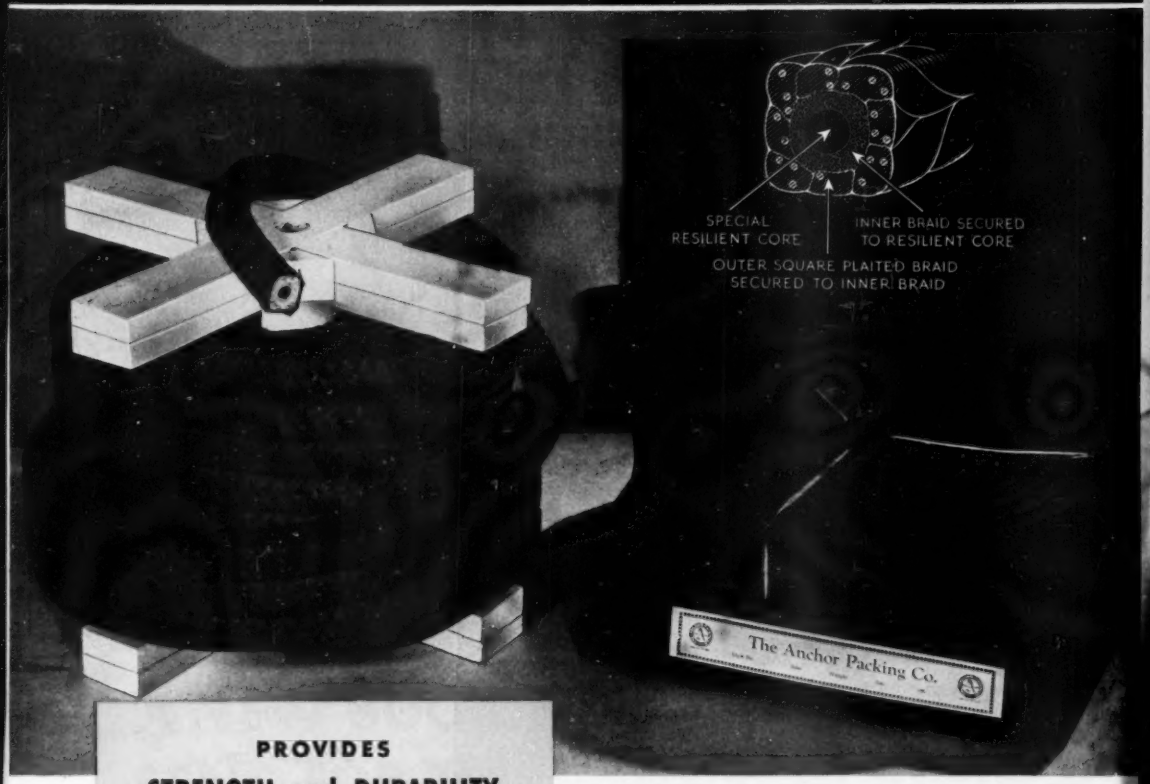
PACKAGED DEHUMIDIFIER

P703 • *Dryomatic* is a portable heavy-duty dehumidifier suitable for many different industries. Precise humidity control down to 15% in rooms up to 10,000 cu ft is obtainable. Model 25CT operating temperature range is —40 to 100 F.
Dryomatic Corp, 812 N Fairfax St, Alexandria, Va.

ARMORED PORCELAIN VALVES

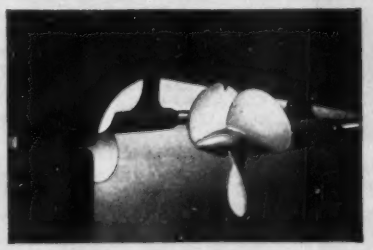
P701 • *Tufclad* valves and fittings are

ANKORITE 387-F FLAX PACKING


SPECIAL RESILIENT CORE
INNER BRAID SECURED TO RESILIENT CORE
OUTER SQUARE PLAITED BRAID SECURED TO INNER BRAID
The Anchor Packing Co.

PROVIDES

STRENGTH and DURABILITY



STYLES

187-F Rings

387-F Coil and on Reels

The resilient core of this packing is bonded to the inner braids with a binder which makes the interior impervious to liquid pressure, permitting the soft outer braids to absorb a portion of the liquid and keep it in contact with the plunger or shaft surface. Soft lead wires, interspersed in the outer braid, are sufficient to promote low friction contact and protect shaft or plunger surface.

This packing may be used against either fresh or salt water; for circulating pumps, high pressure hydraulic apparatus, hydro-turbine shafts, water works pumps, ship propeller shafts. For high or low pressures; temperatures to 200° F.

In sizes ¼" and up. Write today for full details.

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CHICAGO, ILL. — PHILADELPHIA, PA.
DETROIT, MICH. — PITTSBURGH, PA.
LOS ANGELES, CAL. — SAN FRANCISCO, CAL.
NEW ORLEANS, LA. — SEATTLE, WASH.
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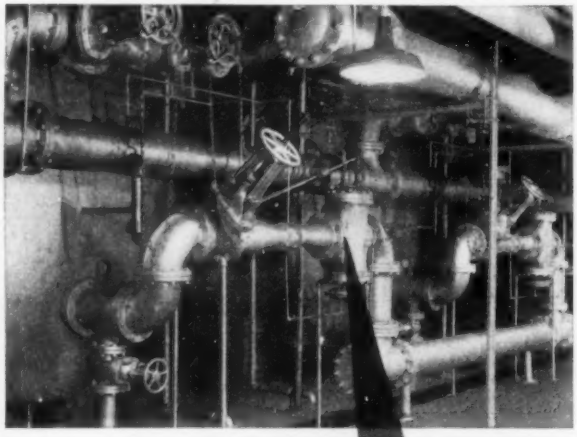
FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

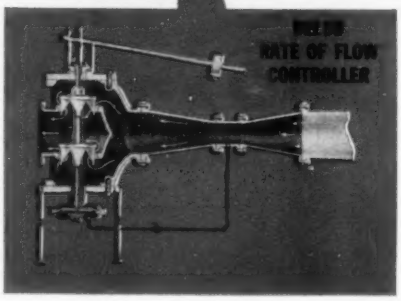
PROCESSES FOR REMOVAL OF WATER IMPURITIES

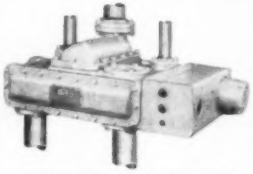
BELCO horizontal filters provide low cost treated water

INCORPORATE AUTOMATIC BELCO RATE OF FLOW CONTROLLERS FOR OPTIMUM CONTROL



Belco provides automatic or manual filtration equipment for any flow capacity. The experience of Belco engineers in process control is unmatched. The Belco Rate of Flow Controller insures constant rate of flow under varying pressure conditions. The unit is sensitive, accurate and designed for low head loss. More information? Ask the Belco man!





BELCO CAMOMATIC VALVE

BELCO AUTOMATIC CONTROL PANELS

For Automatic Control of processes in all industries.

Belco process control know-how is unmatched. You'll find Belco equipment saving money in many prominent plants. Ask your Belco representative how you too can save money, automatically.

★We invite your consultation regarding all water conditioning requirements. Get acquainted with our organization for authoritative assistance and close cooperation. Write for late descriptive bulletins.

Belco

Belco Industrial Equipment Division, Inc.

PATERSON 3, NEW JERSEY

OUR REPRESENTATIVES SEE YOU IN THOMAS REGISTER

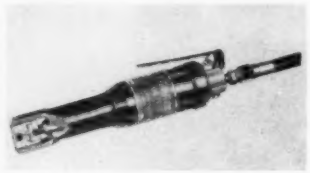
More EQUIPMENT NEWS

Begins on page 154

made of zero-porosity porcelain armored with multiple layers of heavy fiberglas woven cloth impregnated with a phenolic resin. Armoring is regularly available on all Lapp standard Y valves, flush valves, pipe and fittings ½ to 6 in., plug cocks, safety valves, and other units.

Lapp Insulator Co, Inc, Process Equipment Div, Le Roy, N. Y.

For more data on these items, use post cards, p 163. Identify request with P and number.



AIR-HYDRAULIC TOOL

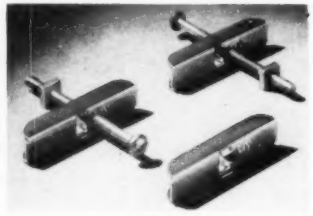
P712 • Direct-coupled, without toggle links, pivot pins, levers or cams, new air-powered hand tool operating on pressures from 75 to 150 psi gives the power of a hydraulic tool in a compact, light, (40 oz) body. It can be taken to any job where an air hose can follow and does an excellent job in operations like staking pressure wire terminals.

Thomas & Betts Co, Inc, 46A Butler St, Elizabeth, N. J.

ENGINE LUBE OIL

P723 • Shell *Rimula* oil, was designed to substantially extend life of automotive type diesel engines and gasoline engines operating in some industrial stop-and-go, low-temperature service. Oil was developed to solve problem of engine wear and fouling caused by certain operating conditions that are aggravated by low loads, high sulphur fuels and low temperature operations.

Shell Oil Co, 50 W 50th St, New York, N.Y.

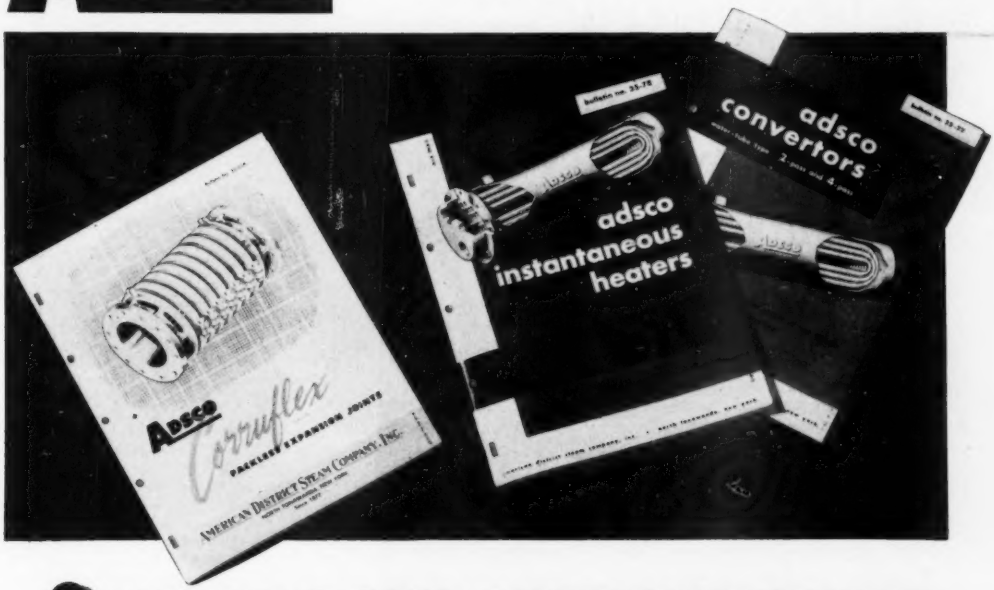


TOGGLE BOLT

P716 • New toggle bolt, *Super-Grip* 3-in-1, may be installed with (1) the head of the bolt outside the wall (2) the nut outside the wall (3) toggles purchased separately and used with any bolt. Toggle head is available for bolt diameters from ⅛ up to ½ in.

Super-Grip Anchor Bolt Co, Inc, 3333 N 22nd St, Philadelphia 40, Pa.

ADSCO TECHNICAL BULLETINS



3 NEW BOOKS JUST PUBLISHED
SEND FOR YOUR COPIES *TODAY!*

● Adsco's three new bulletins—one on Corruflex Packless Expansion Joints, one on Instantaneous Heaters, and one on Convertors—are the most authoritative in the industry. These new bulletins will provide ready information you will always need. *Here they are:*

1. CORRUFLEX . . . 28 pages with complete information on selection, specifications, and installation; 9 pages of tables on weights and dimensions. Drawings of 3 typical piping arrangements; 29 drawings of basic joints and their variations.

2. INSTANTANEOUS HEATERS . . . 56 pages, with 49 pages of tables. Capacities and pressure drops for 198 heaters at 9 steam pressures and 12 temperature ranges. Special information and tables on coolers and on booster, swimming pool and other types of heaters.

3. CONVERTORS . . . 32 pages, with 24 pages of tables. Capacities and pressure drops for 148 convertors at 7 steam pressures and 15 temperature ranges. Detailed instructions on how to select a convertor. Special charts and information on problems related to convertors.

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MAIL THIS COUPON TODAY!

AMERICAN DISTRICT STEAM COMPANY, INC. Dept. PO-7
North Tonawanda, N. Y.

Please send me the bulletins checked:

- ☐ Corruflex Packless Expansion Joints
- ☐ Instantaneous Heaters
- ☐ Convertors

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Company _____

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Planned for Expansion...
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HEAVY-DUTY STEEL BOILERS

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JEWISH AGED
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Three Kewanee Heavy-Duty Oil-Fired Boilers installed by

A. D. JACOBSON PLUMBING and HEATING CO.

In planning institutional buildings today . . careful consideration must often be given to later expansion of *both* building and equipment facilities.

Kewanee Boilers are capable of producing *more steam* than is guaranteed by their rated capacities, hence are ideally adapted when later expansion is needed. This fact plus a well known dependability and economy of fuel makes Kewanee the logical selection for important buildings of every type.

KEWANEE BOILERS

KEWANEE-ROSS CORPORATION
Division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS

Serving home and industry

More POWER NEWS

Begins on page 148

Vulcan lines of steam-plant equipment.

The Northern Equipment Division, of Erie, Pa., makers for many years of Copes feedwater regulators, desuperheaters, pressure-reducing valves and other boiler controls, has been consolidated with Vulcan Soot Blower Division of DuBois, Pa. The new unit, known as Copes-Vulcan Division, has just taken up headquarters in a new plant at 939 W 26th St, Erie.

This new plant provides twice the total space of two former locations. Facilities for engineering, research and manufacturing have been substantially expanded and modernized. So have the executive, administrative and sales offices.

George L Davis is president of Copes-Vulcan Division with Edwin W Nick chairman of the board. Other officers are: William L Hunter, vice-president; W N McCreight, secretary; Edward W Scarlett, controller; Mary C Kelly, asst controller.

D E Hibner, Jr, is vice-president, sales, and consulting engineer. Other sales executives are: W J McDonough, general sales manager; Don Allshouse, advertising manager; Paul G McHenry, manager, proposition dept; W E Veenschoten, manager, foreign sales.

The engineering staff includes: V V Veenschoten, vice-president; F W Bunting, chief engineer; and Joseph Kissick III, assistant chief engineer. H H Weining is director of research and development, with Henry S Knarr and Robert F Painter as assistants.

Coming Events

Sept 8-12—Seventh National Instrument Conference and Exhibit, Public Auditorium, Cleveland, Ohio. Instrument Society of America, 1319 Allegheny Ave, Pittsburgh 33, Pa. and the Industrial Instrument and Regulator Div of the ASME, 29 W 39th St, New York 18, N. Y.

Sept 9-13—Seventh National Chemical Exposition, Coliseum, Chicago, Ill. Chicago Section, American Chemical Society, 86 E Randolph St, Chicago 1, Ill.

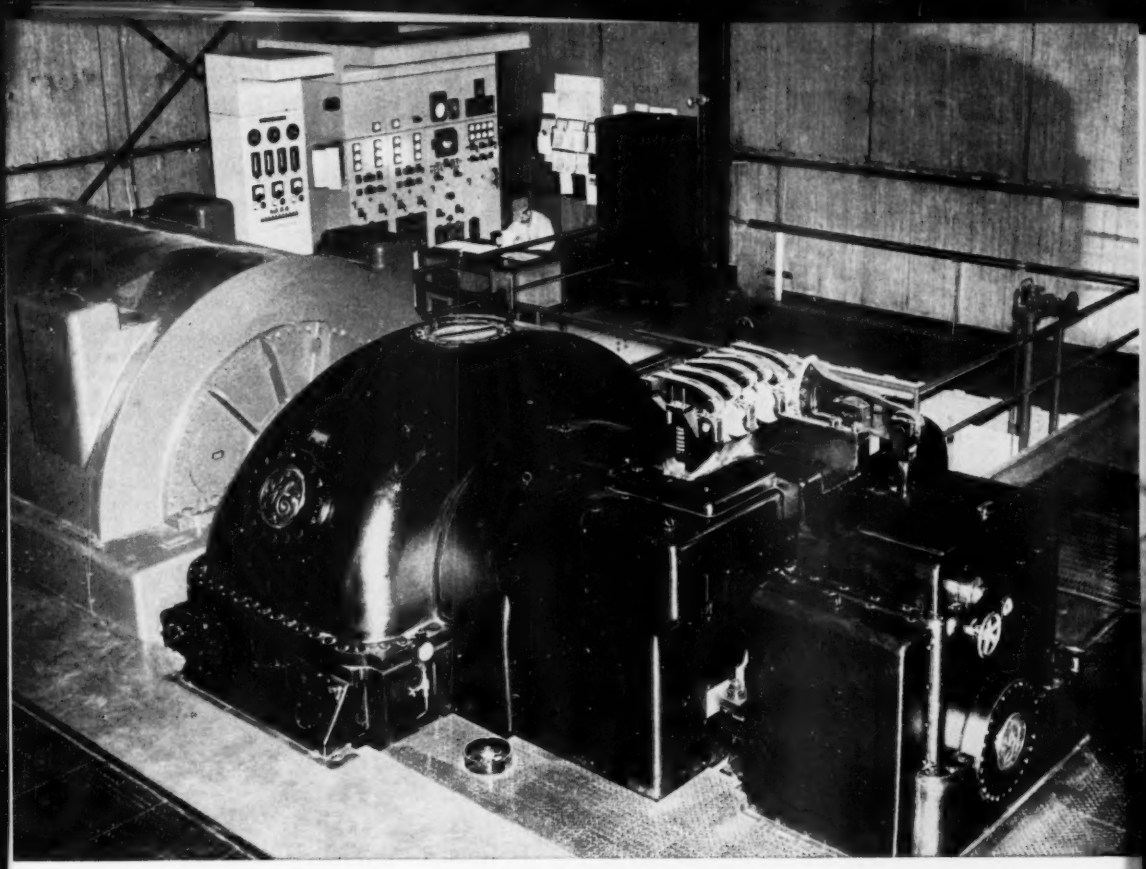
Sept 11-12—Centennial of Engineering, Chicago, Ill. Energy Symposium sponsored by ASME, 29 W 39th St, New York 18, N. Y.

Sept 22-24—Petroleum Div, ASME, Hotel President, Kansas City, Mo. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

Oct 19-24—Annual Meeting American Welding Society, Bellevue-Stratford Hotel, Philadelphia, Pa. J G Magrath, secy, AWS, 33 W 39th St, New York 18, N. Y.

Oct 30-31—Fifteenth Joint Meeting, ASME Fuels Div, American Institute of Mining Engrs, Philadelphia, Pa. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

(*More Power News on page* 186)



Assures trouble-free lubrication for life of new turbine

There is good reason to believe that this new 15,000-KW turbine at Ottertail Power Company's Ortonville, Minnesota, plant will never have to be shut down for oil replacement, oil system cleaning, or because of oil acidity troubles. The basis for this conviction can be found in the company's own experience with NONPAREIL Turbine Oil, lubricant for the new unit.

Since 1931, the Ottertail Power Company has put NONPAREIL into several turbines. In one of those first units, NONPAREIL has now served for 21 years, and the original fill of oil has never needed to be replaced. Although the lubricant has not been removed for treating, it has maintained a neutralization number below 0.09 mg. KOH/gm. The oil system has not required cleaning.

With this evidence of long life is the written guarantee given with each fill of oil that NONPAREIL will last as long as the turbine and will maintain a neutralization number below 0.15 mg. KOH/gm.

You can assure trouble-free lubrication for the life of your turbines by using NONPAREIL Turbine Oil. Phone your Standard Oil Company (Indiana) office for the services of a Standard lubrication specialist. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

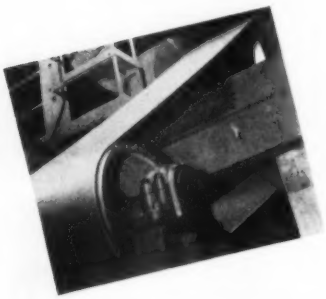
NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY *(Indiana)*

"Cultivated" Hides

THE FOUNDATION FOR LESS COSTLY, MORE PRODUCTIVE DELIVERY OF POWER

By means of expert "cultivation" *raw hides* of the finest quality are transformed into Rhoads Tannate Leather Belting. Through Rhoads exclusive tanning processes, the natural characteristics of leather are developed to a much greater degree. For instance, its strength is made stronger . . . and its physical grip on pulleys made glove-like. It's made to withstand shock and long hours of continuous operation. These qualities are built into Tannate by special "cultivation". They give Tannate belting higher capacity, longer life, than any ordinary oak belting. Write for Rhoads new Data File on the application of Tannate Leather Belting on short and long center drives. J. E. Rhoads & Sons, 35 N. Sixth St., Philadelphia 6, Pa.



Tannate®

IN ACTION

This chipper drive in a mid-western paper mill demands the high capacity of Tannate Leather Belting to absorb the intermittent, heavy shock loads . . . thus protecting motor and bearings.

250 J. E. RHOADS & SONS PHILADELPHIA • NEW YORK CHICAGO • ATLANTA YEARS PRODUCING FINE LEATHERS

More POWER NEWS

Begins on page 148

Tavazzano Power Station Uses Natural Gas Fuel

The first Italian steam power plant to use natural gas fuel, and the first ECA sponsored venture to combine the cooperation of American and European engineers and manufacturers, was dedicated at Tavazzano, near Milan, Italy, on June 1.

The Societa Termo Elettrica Italiana (STEI) made the announcement through Dr Valerio Havas, consulting engineer of New York City. Dr Havas served as American liaison engineer during the two years of its planning and construction.

Tavazzano power station marks a turning point in Italian economy, so far exclusively dependent on hydro and on foreign fuel. This plant, in the industrial heart of the country, will burn natural gas from newly developed nearby wells in the Po valley.

Before the war, Italy's electrical industry was based almost entirely on hydro power. No generating capacity was added during the war, the end of which found Italy in a desperate situation. Its industrial centers were destroyed, its power plants shattered. Then the country had several consecutive years of drought.

At that point the Marshall plan made it possible to add up-to-date steam power plants. At Tavazzano only equipment not obtainable in Europe was financed through ERP funds.

This 125,000 kw power station compares favorably with the most advanced ones in the U.S. It was planned, designed and erected by Montecatini Corp, Italy's foremost chemical combine, and one of STEI's holding companies. The two 62,500-kw turbine-generators and their auxiliary equipment were manufactured in Europe, while the steam generating equipment, their complex controls and some other special equipment were built in the U. S.

The two boilers, manufactured by Combustion Engineering-Superheater of New York, are reheat cycle units, each delivering 475,000 lb of steam per hr, at 970 F, 1850 psi. These are the first entirely outdoor boilers installed in Europe.

Synthetic Gasoline Still a Dream?

Synthetic gasoline is not an ersatz substitute for today's fuel and it's not a miracle substance. It is simply a gasoline refined by familiar processes from crude oil derived from coal or oil shale. And it's going to have to make its own way by competing with present-day fuel on a basis of price and quality.

Government plans to make synthetic gasoline from coal by hydrogenation "are most unlikely to succeed" in providing such a competitive motor fuel according to L C Kemp Jr, director of research for the Texas Co, in a speech before the National Petroleum Association convention.

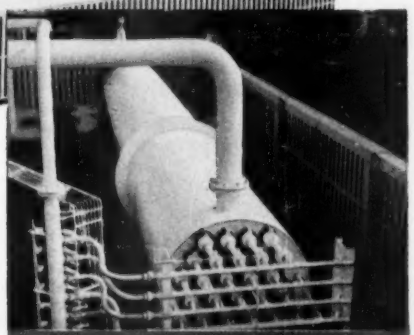
A good deal of confusion has arisen over contrasting industry and government figures covering the cost of turning the nation's coal and oil shale deposits into gasoline.

fluor's modern research facilities

test new developments — verify efficiency

At Fluor, the proof of the design is in the testing. *Before* new Cooling Tower developments are incorporated into standard design, they are subjected to rigorous tests in this modern, commercial-size tower testing laboratory. Here, design and performance efficiency of every new development is determined through complete ranges of actual heat transfer conditions. Realistic rating data is established under conditions *paralleling* those of plant and process operations.

Fluor Cooling Tower Testing Facilities. This commercial-size installation consists of a pump house, instrument house, 20,000,000 BTU/H boiler, test basin, and a 40′ high test tower.



This specially designed Dutch Marine-type boiler provides varying heat loads to the test tower. Fired by 37 hydraulically-controlled burners operating on either natural gas or propane, the boiler delivers a maximum heat load of 20,000,000 BTU/H.

Testing is controlled from this single panel. Instrumentation includes measurement and recording of heat loads and water flow rates, air temperatures, hot and cold water temperatures, air static readings and all other pertinent data, under a variety of conditions.

What this means to you . . .

The motivating power behind Fluor's continuous research and development program is to *always* provide the most efficient cooling tower available. This fact, combined with Fluor's 30 years of active experience in designing major cooling tower installations for the petroleum, chemical, and power industries, means many things to the man seeking a factual tower recommendation to meet his exact cooling requirements.

A Fluor Cooling Tower recommendation means that all variables are included and compensated for. It means that all component parts, as well as all design theory, have been tested and evaluated under actual operating conditions. And, it means that a Fluor-designed cooling tower will perform at *rated* heat transfer efficiency under the conditions of installed operation. *You can be sure with Fluor!*

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Please send me Borden Catalog No. AT-253.

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co. name.....

st. and no.....

city, state.....

See our Catalog in Sweets

More POWER NEWS

Begins on page 148

Last year the Bureau of Mines, which is advocating an immediate coal-to-oil program, announced synthetic gasoline could be made by coal hydrogenation for 12 cents a gallon. The National Petroleum Council on the basis of studies requested by Interior Secretary Oscar Chapman placed the cost at 41 cents a gallon.

Schedule 5 Pipe Conserves Stainless Steel

Because nickel and other alloys are in short supply, more and more emphasis is being placed on light-walled Schedule 5 stainless-steel pipe. This new pipe, produced by several mills, recently received the approval of the Correlating Committee of the American Standards Assn.

When compared with heavier pipe, such as the well-known Schedule 40, this new pipe schedule provides two or three times the pipe footage per pound of stainless steel. Thus, in addition to conserving critical alloys, Schedule 5 stainless pipe gives outstanding savings in cost for material. Made from the standard stainless analyses as set up by the American Iron and Steel Institute, the pipe offers full corrosion resistance in every respect.

From the strength standpoint, Schedule 5 stainless pipe is satisfactory for the vast majority of applications in industry. It will provide an excellent margin of safety with working pressures up to 150 psi. In the smaller diameters, below 2 in. OD, working pressures can be considerably higher.

Comparison of the wall thickness of Schedule 5 with Schedules 40 or 10 stainless pipe shows that the new schedule gives a considerably larger inside diameter, and thus a larger internal cross-sectional area. Outside diameters of the pipes are identical, which facilitates the use of Schedule 5 with existing installations of Schedule 40 or Schedule 10 pipe.

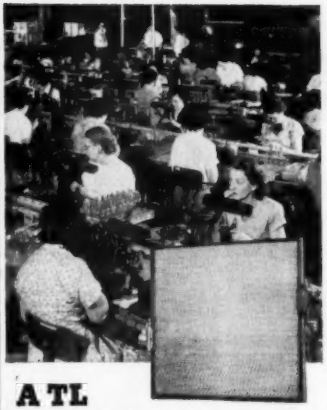
Atomic Energy Commission Considers Reactor Studies

The Atomic Energy Commission recently announced negotiations are nearing completion with four groups of business and industrial firms under a previously announced program for expanded participation in reactor development projects and that no additional groups can be admitted at this time.

The four proposals provide for special studies of the practicability of business and industry building and operating reactors for the production of fissionable materials and power. They are submitted by: (1) Monsanto Chemical Co, St. Louis, and its associate, Union Electric Co of Missouri, St. Louis (2) Detroit Edison Co of Detroit and Dow Chemical Co of Midland, Mich. (3) The Commonwealth Edison Co and the Public Service Co of Northern Ill., of Chicago (4) Pacific Gas and Electric Co and Bechtel Corp of San Francisco.

Agreements have already been signed

(*Continued on page 206*)



A TL from TV

YES, a large electronics tube manufacturer** handed FAR-AIR* filters a real compliment. He had experienced many rejects in his tube filament coating department, primarily due to heavy dust conditions. Even though automatic air filters were installed, rejects continued to be high. Oil entrainment and air pressure loss from dirty filters also caused difficulties. Maintenance of the filters was frequent and costly, too.

On Farr engineers' recommendation, an installation of Type 44 standard FAR-AIR panel filters was made. Results were astonishing! Electronic tube rejects due to dust dropped over 90% and filter maintenance was practically eliminated by comparison. Based on these results, this manufacturer purchased almost 1,000,000 CFM of FAR-AIR filters!

Under practically any condition, you can improve your air filtration by installing FAR-AIR. The unique herringbone-crimp media design plus many other quality features insures cleaner air, up to 50% less maintenance, lower pressure loss and fewer filters required to handle the same volume of air.

Farr field engineers will be glad to help you properly solve your air cleaning problems. Write today for complete information to Farr Company, P.O. Box 10187, Airport Station, Los Angeles 45, California.

FAR-AIR FILTERS
"Better by Farr"

**Name furnished on request
*Trade Mark Reg.

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Lunden, Hayward & O'Connor, architects;
Ralph E. Phillips, mechanical engineer;
Howe Bros., heating contractors; Los Angeles

On 24-hour duty

IN HOSPITALS

JOHNSON AUTOMATIC TEMPERATURE CONTROL

for labor-saving comfort and safety

In the thoroughly up-to-date Good Samaritan Hospital in Los Angeles, 70 Johnson *Individual Room Control* Thermostats are on "24-hour duty," working around-the-clock to maintain precisely the proper temperatures for every purpose. The room thermostats operate Johnson mixing dampers at the double "tempered and warm air" plenum chambers of the 15 central-fan heating systems in the building. "Behind the scenes," other Johnson instruments, valves and dampers are on continuous duty, so that the temperatures of the air, for heating and for ventilation, are controlled at exactly the right levels in those plenums.

With Johnson Automatic Control in command, hospital personnel are relieved of such oft-recurring chores as operating radiator valves and checking room temperatures. Assured of comfort and safety for patients, the staff is free to devote more time to professional duties . . . and with added energy—thanks to Johnson Temperature and Humidity Control.

Johnson Control meets the most exacting safety requirements. *Pneumatically* operated, it is always safe, even in the presence of explosive anesthetic gases. Also, Johnson Humidity Control guards against the dangers of static electricity.

Whether the problem involves control of temperatures and humidities in a single operating room or an entire hospital, call a Johnson engineer from a nearby Branch Office. His advice is yours for the asking. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

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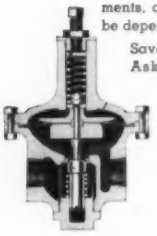
for efficient operation

Clark Pressure Reducing and Regulating Valves

are precision-made for positive pressure control on air, gas or steam lines.

Where different types of equipment, with varying pressure requirements, are operated from a common line, Clark Regulating Valves can be depended on to deliver automatically the "just right" pressure to each.

Save on fuel, maintenance and protect expensive equipment. Ask your Clark representative to specify the right Clark valves for your needs . . . or write us direct.

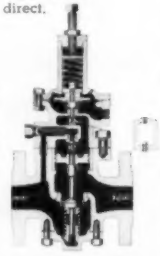


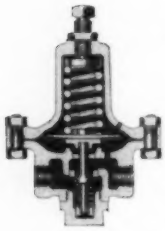
TYPE KRV

Pressure Reducing Valve. Diaphragm Operated-Single Seated Valve. Sizes ½" to 1½" for initial pressures up to 250 P.S.I. Reduced pressures to 85 P.S.I.

TYPE CRV

Pressure Reducing Valve. Integral pilot controlled, piston operated. For pressure control from "dead end" to full capacity. Sizes ½" to 6".





TYPE ORV

Pressure Reducing Valve. ⅜" and ½" Single Seated, Spring Loaded, Diaphragm Actuated. For initial pressures to 250 P.S.I. Reduced pressures to 200 P.S.I.

QUICK-CLEANING STRAINERS

Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S. For pressures to 250 P.S.I.

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THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

More TECHNICAL BRIEFS

Begins on page 150

before firing. Others stated the sulfite waste liquor could not be burned alone in a conventional furnace.

An experimental refractory-lined furnace of 25 cu ft capacity has been constructed to study the ignition and combustion characteristics of this waste fuel. The sulfite liquor, concentrated to 55-60% solids, readily ignites and burns with a relatively long, orange-colored flame of medium brightness. The stability of combustion indicates that the sulfite liquor will burn alone, and a redesign of the firing equipment can be expected to result in improved performance. *ASME paper. No. 51-S-21.*

Directions for ordering papers on p 152

Field Tests of Oil and Gas Residential Space Heating. *By A L Carroll, Consolidated Edison Co of N. Y.*

This report covers fuel usage for an entire heating season of residences in Westchester County (a suburb of New York City). Fifty-one used domestic fuel oil, and 56 others used manufactured gas for space heating. Suitable corrections were made for variations in house construction, insulation, temperature and other factors to arrive at a common factual relationship between the two fuels.

The project was to establish a quantitative relationship between the gallons of oil and cubic feet of 537 Btu gas in therms (100,000 Btu) required to do a given heating job. Further, it was agreed that the significant point was the actual use of gas and oil in the average home during a normal heating season, and not efficiencies determined either in a laboratory or in a test residence where conditions were artificial or controlled.

The calculated hourly heat loss of the house on a zero day (accepted design temperature for the territory) served as a common denominator. All heat loss calculations were made on a uniform basis, taking into account the size of rooms, use of storm windows, weather stripping, insulation, amount of glass, etc.

To reduce all data to a common base, the net gas used for space heating was adjusted to a normal heating season, based on the 5,090 degree days that are considered normal for this area.

Consolidated Edison found that oil required daily for heating hot water in the boiler during the 248 winter days, over and above that required for space heating, was one-half the daily use for hot water heating in the summer. When they used this basis in adjusting data from houses using oil for both space and water heating, there was a close

HOW Carey HELPS THIS

power plant in the sky

KEEP OPERATING COSTS down to earth

Arapahoe Station, Public Service Company of Colorado

B & B Engineering and Supply Co. Inc., Houston, Texas—Insulation Contractor ● Ebasco Services, Inc., New York City, Design Engineer and General Contractor

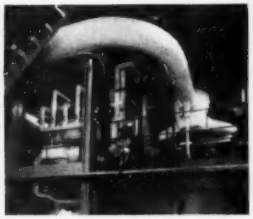
At this new 132,000 kw, steam electric generating plant – built at an elevation of over 5200 feet – Carey insulation products conserve heat, save fuel, help satisfy the West's growing appetite for low cost power.

Carey insulation products were chosen for Arapahoe on the strength of their proven ability to meet, economically, all requirements for strength, light-weight, dimensional stability and performance on a wide range of equipment, operating at temperatures to 900° F.

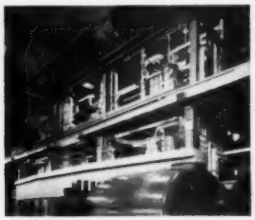
Development and manufacture of products for heat conservation has been an important Carey service to industry since 1873. That's why we believe we can solve *your* heat conservation problem, no matter how unusual it may be. The Carey line includes new, monolithic Super-Light 85% magnesia in molded pipe coverings, blocks and cements – now being manufactured in our new multi-million dollar plant. This material is light-weight, strong, easy to handle, easy to apply. It will not disintegrate or crack under normal service conditions and can be removed and reapplied, when necessary.

Call on Carey for the solution to your heat conservation problems. Use the coupon to request the latest bulletins describing uses for Carey insulation products. If you wish, the coupon will also enlist for you the services of a qualified Carey Industrial Sales Engineer. No obligation.

● In the boiler feed pump room, feed water discharge lines and recirculating lines are insulated with 2" thick Carey 85% magnesia insulation. Finish is 8 oz. canvas on rosin sized paper. Boiler feed water suction lines insulated with Carey standard thickness 85% magnesia, finished with 8 oz. canvas over rosin sized paper.



● The main steam lines and stop valve to turbine, where operating temperatures reach a maximum of 905° F. 8" and 12" pipe, insulated with 2" thick Carey Hi-Temp and 2" thick Carey 85% magnesia, finished with ½" Carey asbestos cement, layer of asbestos paper, layer of asbestos cloth, sewn on with copper wire.



● View of Arapahoe Station from turbine floor. Elevation 5287'. Workmen are applying 8 oz. canvas to lines.

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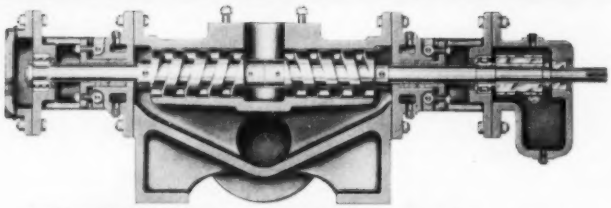
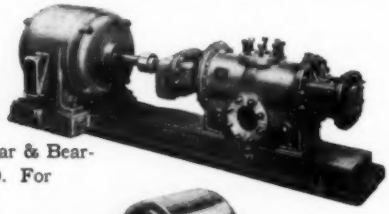
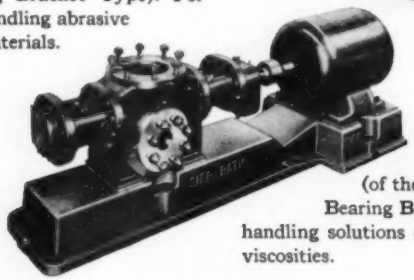


NEW EXTERNAL GEAR & BEARING BRACKET TYPE For handling non-lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for water.



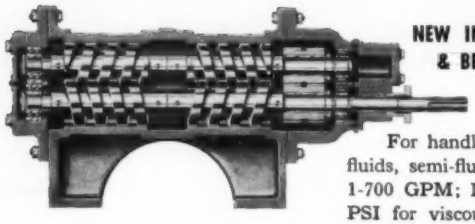
NEW LINER TYPE

(of the External Gear & Bearing Bracket Type). For handling abrasive materials.



NEW HOPPER TYPE

(of the External Gear & Bearing Bracket Type). For handling solutions of extremely high viscosities.



NEW INTERNAL GEAR & BEARING TYPE

For handling lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for light oils.

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Also Manufacturers of Precision Gears and Flexible Gear Couplings

More TECHNICAL BRIEFS

Begins on page 150

correlation with the data for houses where oil was used exclusively for space heating.

Paper features numerous tables, charts. *ASME paper. No. 52-SA-21.*

Directions for ordering papers on p 152

Detonative Phenomena in Gaseous Mixtures. *By L B Morrison, University of Michigan.*

The normal combustion rate of homogenous gas mixtures is largely governed by the multiple diffusion processes in and around the flame front. These processes are leisurely and normal propagation rates are a few feet per second. Under certain favorable conditions, however, combustion waves develop extraordinary velocities of several times the speed of sound. This phenomenon, or detonation, may be regarded as a shock wave followed by combustion, the combustion being initiated by the high temperatures accompanying the shock rather than by the diffusion processes mentioned above.

Most theoretical investigations of detonation treat its thermodynamic aspects. They pay special attention to changes of state across the wave. The significance of the dynamic aspects of the wave is obscured by eliminating velocity terms in the conservation equations. This investigation points out the functional dependence between thermodynamic properties and dynamic properties of a detonating mixture.

The field of jet propulsion places a practical value on such an investigation. A clearer understanding of the phenomena might make it possible to (1) eliminate unintentional detonations in combustors (2) deliberately design a jet device with a detonation as part of the thermodynamic cycle. In a shock tube, shock waves precipitate detonation of various fuel-oxygen and fuel-air mixtures. Experimental detonation velocities are obtained and correlated by means of two dimensionless relations, one a heating parameter and the other the Mach number of the detonation. Spark Schlieren photographs of detonation waves indicate the existence of flow instabilities in lean detonating mixtures. *ASME paper. No. 52-SA-20.*

Motor Selection

Motors for Intermittent Loads. *By R H Wright, Westinghouse Electric Corp.*

Changing conditions in the steel industry have shifted the approach to the problem of applying equipment for intermittent rolling mill loads. Improved

"Tycol Aturbrio Oils have high oxidation resistance... cut turbine shut-downs"

Tycol Aturbrio Oils are unexcelled for long turbine life. They provide resistance to oxidation and protect against corrosion.

Further, Aturbrio Oils have excellent demulsibility properties. Turbine Operators using Aturbrio report minimum wear . . . utmost turbine efficiency . . . greatly decreased maintenance costs.

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Because CORAVOL Circulates to Control Corrosion

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** *you* will use is formulated to do the best protective job under your own plant conditions.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special chemical formulas for: boiler feed water . . . foam prevention . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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More TECHNICAL BRIEFS

Begins on page 150

design of synchronous motors and the increasing capacity of power systems have often made it possible to eliminate flywheels. Synchronous motors may be used either for direct drive on certain constant speed applications or to drive generators for supplying adjustable speed or reversing drives. Before selecting a synchronous motor for either application, it is desirable to determine how its inherent characteristics will affect the power system.

If load is applied to a synchronous motor gradually, the input from the line will also rise gradually with no transient variations. If the load is applied suddenly, the rotor will oscillate and the line input will fluctuate rapidly and violently until the oscillations are damped out. Similar mechanical and electrical oscillations occur when load is released suddenly. On short mill passes, oscillation will be continuous throughout the pass and for some time after.

When a synchronous motor-generator supplies a reversing drive, reverse power peaks are also reflected to the ac line. Field tests show that the total variations of ac power can easily be 400-500% for normal reversing mill loads. A number of drives are in successful operation in favorable locations under such conditions. Power system limitations will probably continue to make it desirable to use induction motors and flywheels for some applications and some locations.

The liquid slip regulator provides the best means for controlling input where an induction motor and flywheel are needed. Average speed of the system is higher and the slip losses are lower than for a fixed slip resistance. Only serious objection to the slip regulator has been its bulk. A completely new design overcomes limitations of the older types. This regulator has forced circulation of the electrolyte and a separate stainless steel heat exchanger. The electrical system is housed in a separate control cabinet and is actuated from a standard current transformer. The setting is adjusted by a small rheostat. *AISE paper. No number.*

Bearings

Various Applications for Composition Non-Metallic Bearings. *By Harry Gilchrist, K W Atwater Engineering, Inc.*

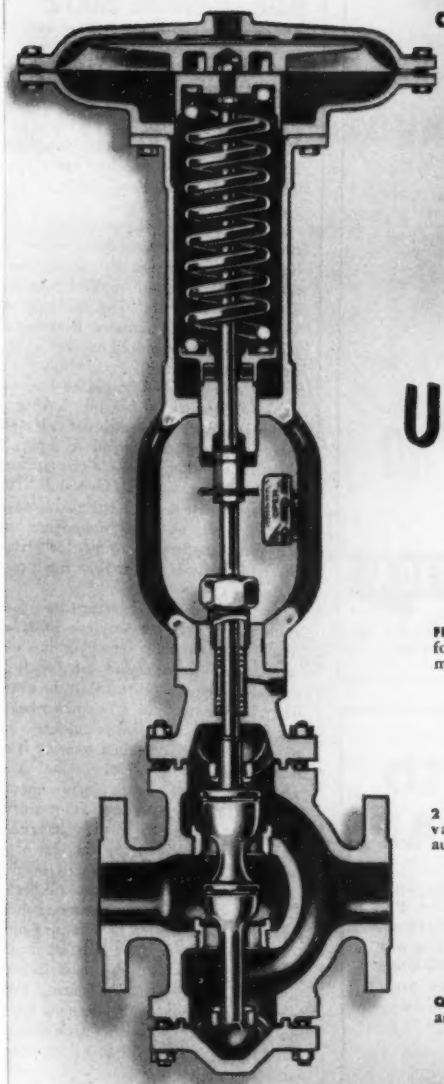
This paper describes the development of composition bearings, starting with the lignum vitae bearing that is the

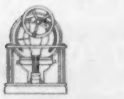
Directions for ordering papers on p 152

Exclusive features of design plus quality controlled materials and workmanship are the reasons

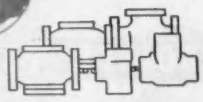
FISHER®

Diaphragm Motor Valves are Universally Preferred

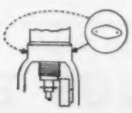




FISHER ALLOY SPRINGS are tested for load tolerances of plus or minus 2½%.



VARIETY OF BODY TYPES and materials—iron, steel, bronze, alloys, single and double seated, angle and globe.



2 YOKE MOUNTING PADS for valve positioner and other auxiliary equipment.

WIDE CHOICE OF INNER VALVES to provide desired flow characteristics.

QUALITY CONTROLLED materials and workmanship.

WALL SECTIONS conform with ASA fittings code.

Fisher offers the most versatile and complete line of Diaphragm Motor Valves—manufactured to handle pressure conditions up to 6,000 pounds. Available in metals for highly corrosive service and alloys for high temperature work. They are built for your specific requirements.

VERSATILE! ECONOMICAL!

Teflon V-Ring Packing, requiring no lubrication, is standard on all Fisher Diaphragm Motor Valves

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Nicholson expansion steam traps were installed by a processor on tank heaters and coils where various unit temperatures from 160° to 185°F were to be maintained. The steam temperature was 320°F. Figuring the difference in heat loss between traps discharging condensate at 160° and others discharging it at approximately steam temperature, they feel the loss was cut nearly in half. On this basis Nicholson expansion steam traps are paying for themselves in many industries.

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TRAPS · VALVES · FLOATS

More TECHNICAL BRIEFS

Begins on page 150

grandfather of the heavy duty nonmetallic bearing. Much work was done with this material to get and develop uniform high quality. The next step was development of composition bearings. These may be classified into two types: laminated bearings and fully-molded bearings.

A laminated bearing is so called because sheets of duck canvas, burlap or linen are impregnated with a condensation resin binder and molded together into the radial form. The thickness of such radial type laminated bearings is made up by the required number of impregnated sheets.

By this method, it would be impractical to produce a bearing having a flange to absorb the end thrust. So most manufacturers recommend a separate thrust flange that is merely cut out and machined from a flat molded slab. The separate thrust flange has its advantage in mills where operating experience has shown that the bearing proper lasts from three to six times longer than the thrust flange.

The fully molded bearings have advantages, as they not only can be more quickly installed by removing the old type brass bearings, but the bearings themselves have a universal grain edge. They can be made as a one-piece bearing with any shape, size or thickness of flange. Resistance against wear or friction is uniform in all directions. The wearing does not change during operation, and the structure is uniform throughout. There are now, for instance, certain formulas whereby the size of a fully molded bearing can easily be derived from the diameter of the roll neck.

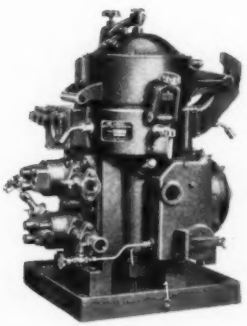
In composition bearings, whether they are made of laminated or shredded material, or whether they are made of virgin vegetable fibre, the most important thing is to produce a bearing that is absolutely homogenous, does not have too large a percentage of resinous contents, and has a smooth, hard wearing surface. Composition bearings should have a relatively small percentage of binding elements, should be strong enough to assure the maximum amount of crushing strength, uniform smooth running surfaces and resistance against wear. *AISE paper. No number.*

Borgana, a trade-marked organic product extracted from red cedar, manufactured by the **Portland Shingle Co,** Portland, Ore., and used successfully by many large plants on the Pacific Coast for about 15 years, will be distributed on a national basis by Strong, Carlisle & Hammond Co, it was recently announced.

DE LAVAL CENTRIFUGING COSTS LESS THAN "DOWN TIME"

The cost of a De Laval Centrifugal Oil Purifier of any given size is only a fraction of the cost of the prime mover it protects. There's no denying it, the comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown. A De Laval machine is truly inexpensive insurance.

A De Laval Purifier instantaneously removes from lube oil, all water, dirt or sludge by means of centrifugal force, keeping the oil clean and safe to use over and over again.



De Laval Oil Purifiers protect power units from ***both*** causes of lubrication failure—they never do a "half-way" job.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
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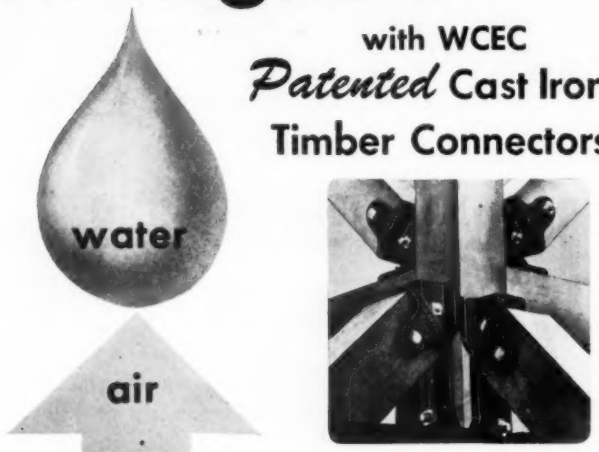
DE LAVAL

for more dependable power production

greatest structural strength...

with WCEC *Patented* Cast Iron Timber Connectors



By use of WCEC connectors, the struts develop their strength as a column by direct bearing on the square end of the strut against a cast iron seat. The connectors spread the horizontal component of the stress in the strut over a large area of the vertical columns, to assure that the allowable resistance of the wood in compression perpendicular to the grain will not be exceeded. The vertical component of the stress is transferred to the vertical column in direct end grain bearing, through shear bars on the timber connector. These patented connectors develop the greatest structural strength of the timber joints, an accomplishment almost impossible to achieve by bolting alone. WCEC cooling towers directly in the path of hurricanes have withstood the test of extreme wind load without damage.

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TOWERS OF STRENGTH WCEC

Typical installation at Bloomingdale's, New York City. Other WCEC towers at Gimbel Brothers, Pittsburgh; Scruggs-Vandervoort-Barney, St. Louis; Sears-Roebuck, Chicago; J. C. Penney Co., St. Louis.

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REPRESENTATIVES IN TWENTY-EIGHT PRINCIPAL CITIES

MARMADUKE

Continued from page 142

—but the valves WERE painted red. Hoses were rolled up and attached to each outlet. Then a small wheel wrench was hung on each valve wheel to help open it in a hurry.

"For some time nothing happened. As in most plants, the valves were never opened to see if they worked, or to make sure employes knew how to open them.

"The place was busy that evening when trouble started as the mill had been running around the clock, unloading boats. And the freight yard and shed hummed with activity. The overworked super took his family to the mainland that afternoon, to a movie. Then someone discovered a fire flaring up from a bale of cotton waste in the freight shed.

"The alarm was given promptly. And that's when all hell broke loose. A foreman rushed a man to the power plant to see that the fire pump was at full speed. One of the truckers grabbed a wheel wrench and tried to open the nearest fire valve. The wheel didn't budge. He was quickly shoved aside by a big burly bruiser.

"'I'll show you how to open that valve,' he roared. Grabbing the wrench he lugged and heaved—but nothing happened. Then he gave one mighty yank. The stem twisted off cleanly as if it had been sheared. For a moment he gazed open-mouthed at the valve wheel, dangling from the wrench's end in his hands. By then the fire was roaring out through the roof, and spreading fast.

"Everyone was in a frenzy, yelling, rolling out hose and trying to open valves. But spindle after spindle twisted off. Valve after valve was abandoned as the flames marched up the long shed.

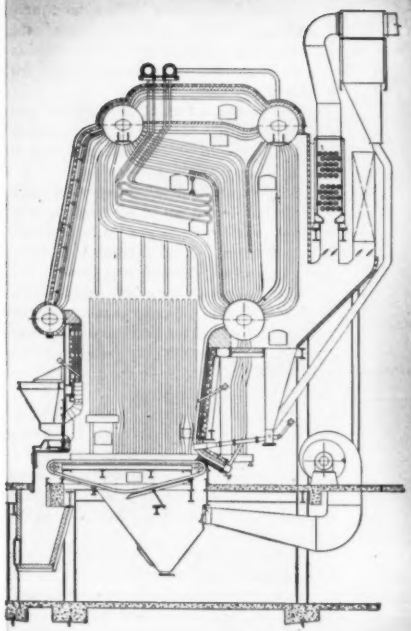
"Someone grabbed a handful of hammers and passed them out quickly. 'Break off the bonnets,' he yelled, 'that'll get some water on the fire.' Bonnet after bonnet was cracked open, but most of the water only gushed out in short puddles as the pressure was relieved.

"With screeching whistles and men milling around madly in confusion, the freight shed slowly burned toward the big grain elevator. The red flames shooting into the black night made it a scene from Dante's *Inferno*.

"When the grain-mill foreman saw the flames nearing his bailiwick, he went into action. It turned out that the master valve for his zone was the only right-handed valve in the system. The foreman put a wrench on it and spun the valve open easily. But ironically enough, by that time there wasn't enough pressure to put out a cigar butt. Those

UNION STEAM GENERATORS AT BURROUGHS . . .

33 Years of UNION Service



Burroughs Adding Machine Co. Have Used UNION Boilers Since 1917

33 years ago The Burroughs Adding Machine Company installed their first Union Boiler. Periodically since 1917 they have added more Union installations. The latest Union "N" Type boiler equipped with Detroit Stoker is operating in the Detroit Burroughs plant.

The history of Union Boilers in constantly expanding business organizations the country over is similar to the Burroughs story.

Obviously the product gives satisfaction.

You will do well to select Union Boilers because Union's 60 years of engineering and manufacturing experience goes to work for you in an installation which fulfills your requirement perfectly.

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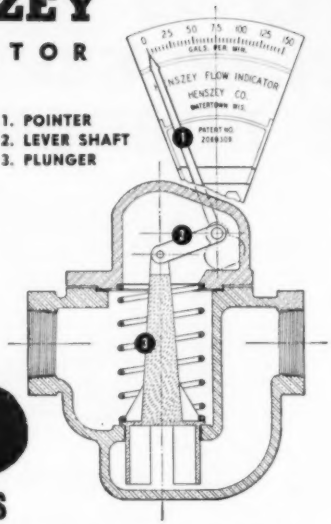
Only 3 MOVING PARTS *in the* HENSZEY FLOW INDICATOR

There are only three moving parts in the Henszey Flow Indicator—the Pointer, the Lever Shaft and the Plunger. And that means longer wear, continued service, and constant accuracy.

The liquid enters the indicator below the plunger, forcing the plunger upward. Slots in the side of the plunger allow the liquid to pass. Increased flow will increase the lift, exposing a greater area of the slots, so that the life of the plunger is in direct proportion to the rate of flow of the liquid. The graduations on the dial are uniformly spaced from one end to another and read direct — without constants. The entire instrument can be installed right in the pipe line.

1. POINTER
2. LEVER SHAFT
3. PLUNGER



For details consult Sweet's Catalog or write:

HENSZEY COMPANY

Dept. D-7, WATERTOWN, WISCONSIN

HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

How Often Does YOUR Power Plant Get Bumped?

NO service is harder on boiler tubes than that of a power house on wheels. Repeated bumps — for car coupling — that would shatter a stationary boiler are routine with steam locomotives.

Many railroads purchase boiler, arch and superheater tubes from us — stocks are broad and complete — service is assured.

Tubes for every use — boilers, condensers, evaporators, heat exchangers, cracking stills, etc. —standard or extra gauge—straight or fabricated.

Other Murray products include stainless and carbon steel pipe, seamless mechanical tubing, pipe fittings, boiler tools and accessories. Write for current Tube Stock Bulletin.

MARMADUKE

Continued from page 198

busted valve bonnets in the freight shed had drained all the pressure.

"He barked to his assistants to cut off the freight-shed line. It was a 4-inch valve and had always been left open. The assistant grabbed a long crane bar. Because this valve was also a left-hander, the stem twisted off on his first try to 'close' it.

"The valves, their designer, and all his ancestors and offspring were cursed from one end of the place to the other. They were cursed individually, then collectively, by everyone as they stood there helpless. Water was all around the island, and the fire pump was running full blast. But there wasn't a drop for the fire.

"Distance between the elevator and shed was 150 feet. And that distance is all that saved the elevator—but it was a mighty close shave.

"During this time the operator-engineer was driven out of his head by constant yells for more and more pressure.

"'What in hell do ya think I got here, a high-speed diesel-driven pump,' he yelled back, cursing a blue streak. 'This old duplex is already tearing out its guts,' he added for good measure. And the noise of her banging crossheads was terrific. Sounded as if she'd knock herself to pieces any minute.

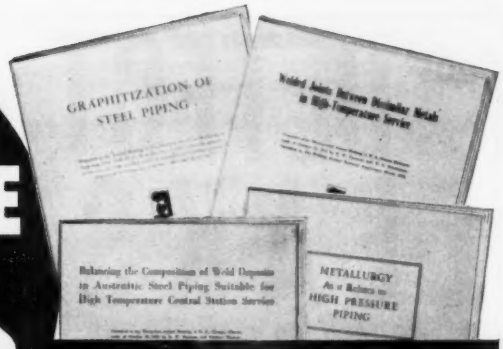
"The sad news was finally gotten to the super on the mainland. He broke all speed records getting to the island, only to find his plant in smoldering ruins. On landing, he broke out in a frenzy and canned every last man on the spot.

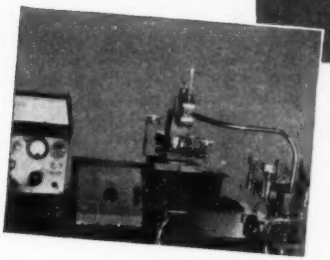
"Next day the higher-ups from the mainland home office descended on the island like a swarm of hungry locusts. They had one of the usual investigations. Why the top brass always investigates AFTER a catastrophe so they can nail the blame on some poor devil, instead of preventing such accidents BEFORE they happen, is something I could never understand.

"What revolutionary discovery did this brain trust come up with? Why, they concluded that left-hand valve should not have been used in the first place. So new underwriter-approved valves were installed. That was months later, of course, after the place was rebuilt. Then for good measure the freight shed was completed with a sprinkling system—all of which should have been put in at the start.

"But as with every story," wound up Marmaduke, "there was one bright spot in this one. That is, there wasn't a whisper of wind that night. If there had been—every building on the island would have burned to the ground."

WHERE KNOWLEDGE IS POWER


GRAPHITIZATION OF STEEL PIPING
Balancing the Composition of Weld Deposits in Austenitic Steel Piping Suitable for High Temperature Central Station Service
METALLURGY As a Science in HIGH PRESSURE PIPING



Knowledge is POWER when it is put to practical use. Here are examples:

- Intensive investigation by P.P.&E. into graphitization of steel piping resulted in the development of materials and methods that inhibit this cause of power piping failure.
- Model testing, as applied by P.P.&E., makes possible complete analysis of a complex piping system as a check against theoretical calculations — thus helps to avoid excessive stresses, reactions, and movements in the final system which could damage anchors and other equipment, and affect joints.
- Ultra-sonic testing — a unique non-destructive method employed by P.P.&E. — assures quality control of materials and welding.

This type of knowledge — plus the practical experience P.P.&E. has acquired during fifty years of specialization IS power — because it results in greater safety, higher efficiency, and longer life from high-temperature, high-pressure piping.

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
785 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
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NOW DETECT LEAKS

faster than ever with

RAYMASTER LEAK DETECTOR

SAVE up to 80% of DOWN-TIME

- SAFE
- PORTABLE
- SELF-POWERED

A fluorescing agent is used in the liquid to be traced for leaks. As little as 5 parts of fluorescing agent may be used to a million parts of liquid. *The Blacklight lamp easily detects leaks through the fluorescence of the agent.*

Absolutely *SAFE from electric shock and harmful rays*, this new PROVEN method detects *positively*, leaks and seepage of the minutest pin-point size.

Liquid leaks in vessels of all sizes and all kinds are rapidly detected. Wetness and other adverse conditions are no obstacles with the RAYMASTER LEAK DETECTOR.

RAYMASTER is battery operated and portable, making it ideal for universal use, especially with

- SURFACE CONDENSERS
- FUEL TANKS
- BOILERS
- VALVES
- FEEDWATER HEATERS
- TRANSFORMERS
- ETC.

This equipment is used by some of the largest power companies in the world. List available on request. Here's what they say . . .

"We have been using your RAYMASTER unit for at least 8 months, and find it very satisfactory; in fact, our condenser men would hate to do without it at any time."

"We have been using your Black Light Leak Detector as an aid to the solution of various power plant problems — it has saved us a lot of time and trouble."

Complete cost of one unit may be absorbed by the saving in Down Time on one inspection.

There's no guess-work with RAYMASTER. For complete literature and price list fill out and mail this coupon TODAY.

GEORGE W. GATES & CO.

Hempstead Turnpike & Lucille Ave., Franklin Square, N. Y.

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Hempstead Turnpike & Lucille Ave., Franklin Square, N. Y.

Please send me complete literature and price list on your RAYMASTER LEAK DETECTOR.

Name ..... Title .....

Company .....

Street .....

City ..... Zone ..... State .....

POWER CYCLE

Continued from page 73

sary supplement to good operation. We return and use all uncontaminated condensate, but we still have a makeup that runs between 30 and 40%.

All makeup water comes from a group of three deepwells. It is fairly hard with a high silica content. Normally an ordinary lime-soda hot-process softening system with supplementary phosphate treatment at the boiler drum would meet power-plant requirements. But such a treatment results in too much sludge formation for good waste-heat boiler performance.

As a result a 2-stage hot-process softener with phosphate treatment in the second stage went in to give a zero-hardness low-silica content feedwater. With a raw water carrying so much sodium and carbonates we found lime need be added only in the first stage.

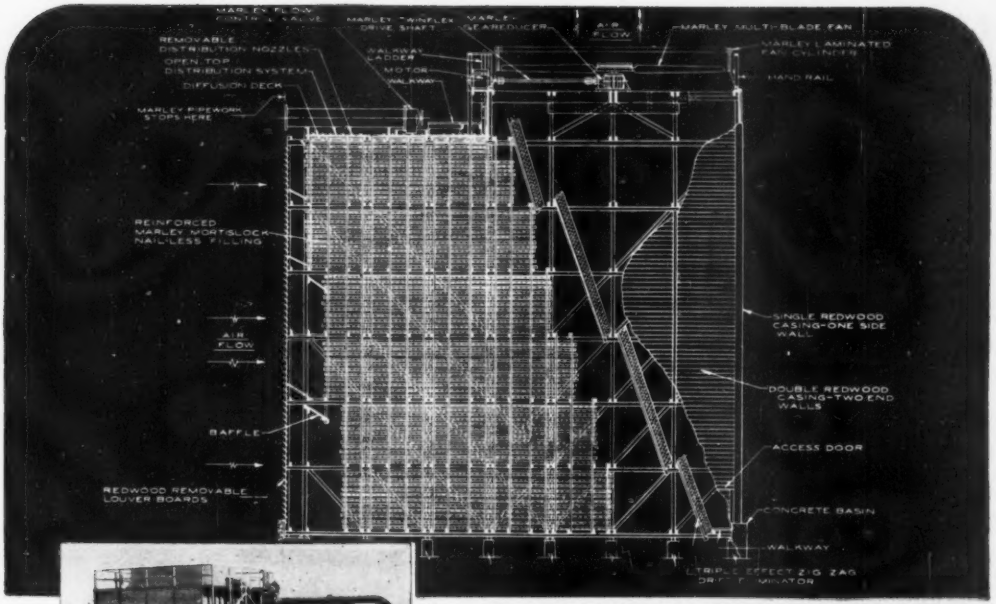
Reaction and sedimentation tanks consist of various compartments and sections to handle both stages of treatment as well as deaerate and store treated water and condensate. After treatment the water goes through anthrafilt filters on the way to the boiler feed pumps. Incidentally, all boiler-feedwater pumps for the entire plant are centralized at the powerhouse to reduce amount of equipment and the load on individual chemical-plant operators in area.

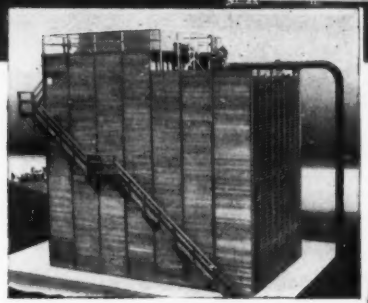
Controls. With our decision to pull saturated steam from high-pressure boiler drums we had to abandon the usual steam-flow air-flow combustion-control systems. Instead, we put in what is in effect a fuel-air flow control, with a master pressure controller on the main steam manifold. As manifold pressure drops, the controller opens the i-d fan damper to admit more air to the furnace. This increased air flow registers on the air-flow meter and, as the air flow pen goes up, the gas flow pen follows it. This causes an air loading pressure to open the fuel-gas control valve and admit more fuel to the boiler. This chain of events continues until the manifold steam pressure approaches the set point on the master pressure controller.

The forced-draft fan works under the action of a furnace pressure controller that maintains furnace pressure constant, regardless of load.

Process Aids. Compression of synthesis gases makes heavy power demands so we decided to equip four 4300-cfm gas compressors with 10-cylinder 319-rpm 875-bhp gas engines. Compressor cylinders mount on the engine side and draw their power from the same crankshaft. They raise a nitrogen and hydrogen mixture from about atmospheric pressure to 5100 psig.

As part of the gas-engine auxiliaries





for MAXIMUM PERFORMANCE with NARROW PLAN AREA

Engineers who know, choose MARLEY Single-Flow

SINGLE-FLOW COOLING TOWERS adapt Marley patented cross-flow water cooling to confined areas, retaining the features that have built and maintained Marley leadership in industrial water cooling.

Some of these design features, such as the full-height louvered end-wall and patented Mortis-Locked filling are most fully utilized in Single-Flow design. That means greater air volume, more breakup, longer air-water contact—it means wide cooling range and close approach to wet bulb temperature.

Open, visible distribution with its many operational advantages is included in Single-Flow engineering. All mechanical equipment is Marley designed and Marley manufactured for cooling tower use exclusively.

The rugged structural strength and long-tested durability that characterize all Marley design are engineered into every Single-Flow tower. Ease of maintenance and safety of operation are functional features of these high performance towers.

Marley Application Engineers, located in fifty leading cities, will gladly give you further information on Single-Flow cooling towers.

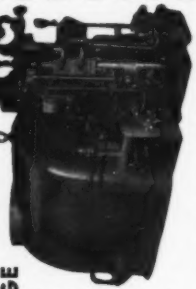
producers of

DOUBLE-FLOW TOWERS
AQUATOWERS
DOUBLE-FLOW AQUATOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.

KANSAS CITY 5, MISSOURI



STEAM TURBINES

TYPE UV MULTISTAGE

• Available with from two to ten pressure stages. Horsepower range from 100 to 4000, steam pressures up to 600± ga., 750° F., condensing or non-condensing. Optional governor equipment and accessories adopt UV Turbines to any mechanical drive within their capacity range.

Contact your Murray representative or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY, BURLINGTON, IOWA

MURRAY

Builders of Steam Power Equipment for over 75 years

we put in a 250-psi compressed-air system for startup and as a backup under other conditions for a separate 100-psi compressed air system used throughout the plant for many services. In addition, we have four instrument air compressors of the air-cooled package type in various process areas for meter-air needs. Then we have a completely separate 25-psi compressed-air system in one process section. Lastly, we have two 11x10-in. 4-cylinder ammonia compressors to meet process refrigeration requirements.

SLOT CONSTRUCTION

Continued from page 84

wire-bands. Latter method has been used in Europe with the inserted-tooth design. Retaining ring generally goes hand in hand with milled-slot construction. Retaining rings in today's machines are usually made from austenitic metals to cut surface losses caused by magnetic field.

Single-Phase. So far we've limited our discussion to 3-phase generators. An unusual design is used in constructing the single-phase generator rotor. And here's why. When a generator stator winding carries a heavy single-phase load, heavy pulsating currents flow in the rotor surface. This means heating of rotor structure. Solution is to provide a suitable low-resistance path for these rotor currents.

This channeling of rotor currents is generally done by building a short-circuiting winding. This allows large currents to flow yet minimizes loss. In effect, this is a cage winding on rotor's surface. Heavy copper wedges forming this cage winding serve a dual purpose. In addition to carrying current it restrains the coils against centrifugal force. Wedge ends are connected by flexible shunts to a copper path embedded in retaining rings.

FURNACE DESIGN

Continued from page 98

Temperature of steam returned to reheater, however, rises with increasing load. So it's advantageous to make liberal use of the drooping characteristic of radiant-heat recovery for the reheater. Heat required per pound of reheat steam becomes less with rising load, while heat recovered by radiation also decreases as load goes up, Fig. 5.

Limiting Factors. Amount of radiant-heating surface that can safely be placed within the furnace area is limited especially for low ash-fusion-temperature fuel. Outer skin temperature of steam-heating tubes is higher than that of

Assures Positive Distance Reading of Liquid Levels

JERGUSON TRUSCALE GAGE

THE modern design JERGUSON TRUSCALE GAGE gives new accuracy for reading of liquid levels in boilers, deaerating tanks, etc.

Here is the remote reading gage which incorporates all of the newest engineering features! The Jerguson Truscale has exceptional sensitivity, with ability to register changes as small as ½ of 1% of range! The translucent dial scale is clearly lighted from behind, and is easy to read.

Available with positive alarm system. Lights and horn signal too high or too low water level.

Visible Alarm

Horn

Repeater

Available with Repeaters which repeat accurate level readings at auxiliary locations.

Marine Operators: *Special installation procedure compensates for roll and pitch of your ship.*

Write for Truscale Catalog

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

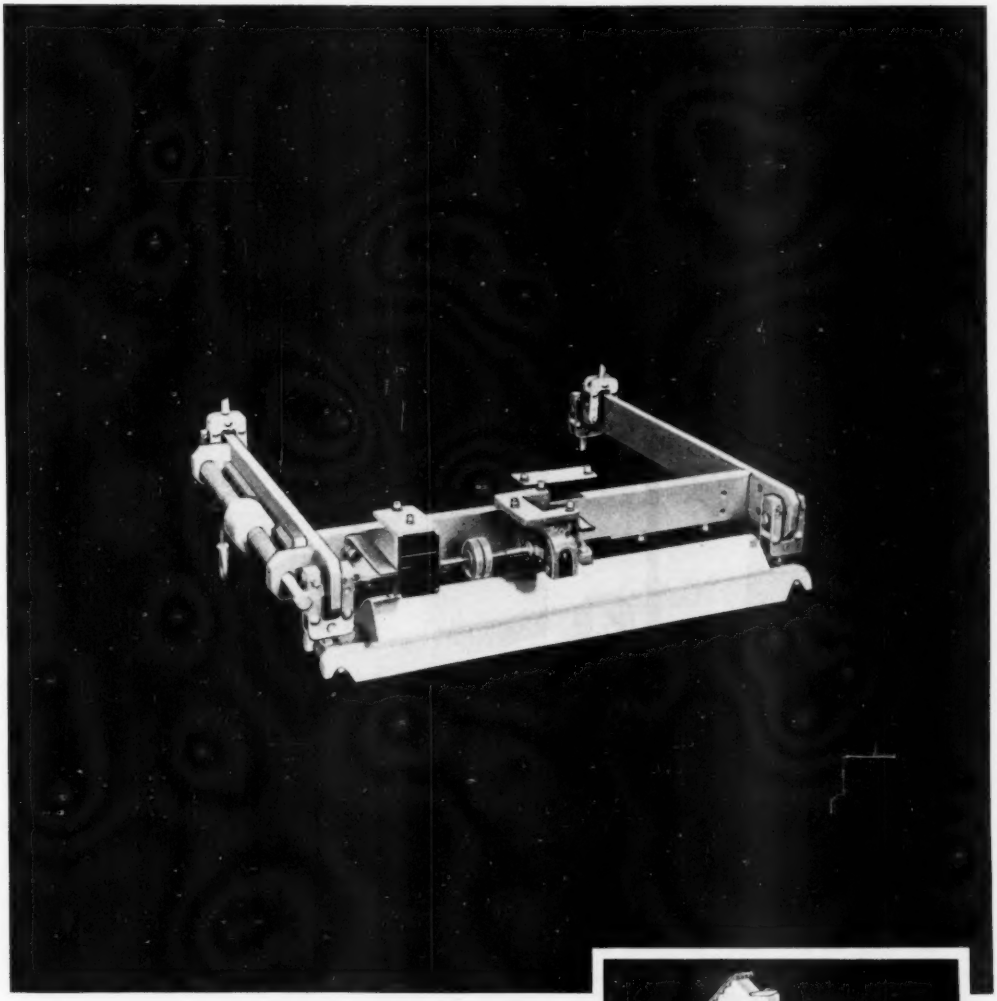
100 Fellsway, Somerville 45, Mass.

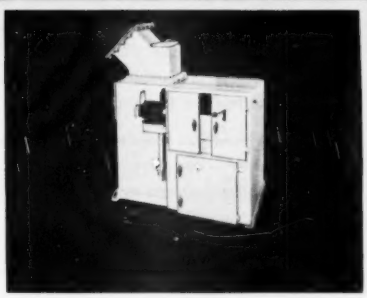
Representatives in Major Cities

Those Listed Under JERGUSON

In Europe: Bailey Meters & Controls, Ltd.

S-E-Co. Coal Scales Are Accurate





S-E-Co. Coal Scales utilize a non-welded steel weigh lever system, steel loops, hardened steel pivots and bearings which give a minimum weight to these parts. This light weight means low inertia, faster action, and therefore a greater accuracy.

Weigh levers that are not welded, do not warp—therefore pivots are in exact alignment and remain so. The entire lever system is located in a dust tight compartment.

For an accurate weight of coal fed to your pulverizer or stoker, use **S-E-Co.** Coal Scales.

SEND YOUR INQUIRY TO **STOCK EQUIPMENT COMPANY**

715 C HANNA BUILDING • CLEVELAND 15, OHIO

3 GUARDIANS FOR YOUR CONDENSERS...

1 Model HCVS (up to 6000 lbs./day) Bulletin 840-J1

2 Model DVSX (up to 400 lbs./day) Bulletin 840-F2A

3 Model CVS (up to 2000 lbs./day) Bulletin 840-F1

These are the three volumetric solution-feed BUILDERS Visible Flow CHLORINIZERS. They're safe, simple, sure — the ideal chlorine gas feeders for chlorinating cooling water to eliminate slime in surface condensers and heat exchangers.

Chlorinizers are easy to install, easy to operate, easy to understand and service. Chlorinizers incorporate a unique Tantalum diaphragm control valve, the only control mechanism which permits changing from manual operation to automatic-proportional control, program control, or multiple-dosage operation right in the field. Capacity changes are equally easy to make due to the sound engineering and simple construction of Builders Chlorinizers.

May we show you how Builders Chlorinizers — by combatting slime in cooling water — can increase the efficiency of your plant operations? For descriptive Bulletins and complete information, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 354 Harris Ave., Providence 1, Rhode Island.

BUILDERS PROVIDENCE *Instruments*

vaporizes, and ash readily sticks to high-temperature surfaces. Furnace wall cleaning may become a serious problem.

Steam-heating surfaces are the most critical part of the steam-generating unit. They cannot be indiscriminately exposed to extreme furnace temperature. Neither is it possible to permit steam temperature within fully exposed radiant surfaces to rise to a level that endangers tube metal. So location and extent of radiant surfaces in relation to heat source requires careful study.

This problem will be discussed in an article to be published in a forthcoming issue.

WITH OUR READERS

Continued from page 5

For older material, we can do either of two things: (1) We can give the exact reference (issue and page) and you can then consult bound volumes of POWER at a library. (2) If you don't have access to a library with a file of POWER, or wish to have a copy of any article for permanent reference, we can furnish photostats made from our own bound volumes. We supply these at cost.

While we do not make reprints of the usual article, we always make reprints of our special sections. Occasionally we make reprints of article series, such as the one completed a few months ago, the "Insulation Handbook." Such reprints are available at standard prices, with discounts for quantity purchases. We will be glad to furnish you a list of reprints currently available.

One final thought: You can help us to help you by being as specific as possible when you make your request. If you're trying to run down an article, or want tear sheets or photostats, please give us the exact title of the article, the author's name and, if possible, the month and year it was published. The author's name is particularly helpful since we have an index by authors. If you don't have any exact information on the article, please try to describe the subject and contents as fully as you can.—ED.

More POWER NEWS

Begins on page 148

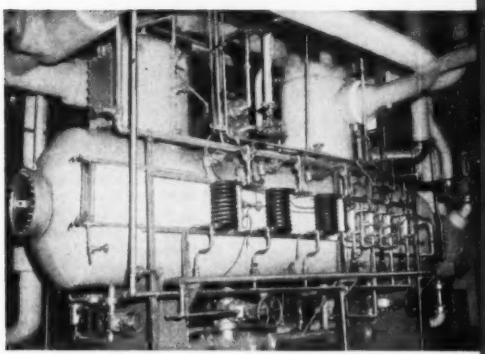
with the Dow Chemical-Detroit Edison group and with Commonwealth Edison-Public Service of Northern Ill. group. The Pacific Gas and Electric-Bechtel group has indicated its acceptance of the agreement. Negotiations are continuing with Monsanto Chemical Co, and the Commission expects early closing of the agreement with it.

A new milestone in **Allis-Chalmers'** expansion in the growing South is the opening of a new, streamlined factory branch at 4646 Peachtree Blvd, Atlanta (Chamblee), Ga. The new 8-acre property is described as the last word in modern and efficient methods for servicing agricultural and industrial dealers.

(*More Power News on page 208*)

Do you need proved power plant equipment? —let this ALCO check list help you

1 Closed Type Feedwater Heaters
2 Evaporator Condensers
3 Condensate Coolers
4 Jacket Water Coolers
5 Lubricating Oil Coolers
6 Evaporators
7 Oil Tank Suction Heaters
8 Fuel Oil Heaters
9 Blowdown Exchangers
10 Aircooled Heat Exchangers
11 Prefabricated Pipe
12 Propane Storage Tanks
13 Large Diameter Water Lines
14 Penstocks



For Example—ALCO Flex-Tube Evaporators have a positive-acting, thermomechanical descaling action.

Making use of this principle, engineers designed a patented arrangement of struts, tension bars and split support plates. The tubes bend or flex when heat is applied to the coil side. When cold water is sprayed over the tube bundle, the tubes contract, and scale cracks off and is flushed away through blowdown openings.

Other important features include:

HEATING ELEMENT SITUATED IN LOWER HALF OF SHELL, provides maximum disengaging area.

SHELL SIZE GIVES AMPLE SPACE under heating element for scale removal.

SMALL SEPARATE REMOVABLE CHANNEL AND COVER eases job of maintenance men.

TWO OR MORE BLOWDOWN CONNECTIONS of large diameter for effective flushing.

UNIFORM COMPRESSION BOLTING assures tight joints but permits quick convenient access to key points for inspection and maintenance.

For more details about ALCO Flex-Tube Evaporators or your other power plant equipment needs, mail the coupon or call the nearest ALCO sales engineer at Beaumont, Chicago, Dunkirk, Houston, Kansas City, Los Angeles, New York or Tulsa.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Dunkirk, N. Y.

In step with tomorrow—**Alco Aircoolers, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

ALCO PRODUCTS DIVISION
American Locomotive Company
Schenectady, New York

P

Gentlemen:
Please send me information on the following items:

1__ 2__ 3__ 4__ 5__ 6__ 7__ 8__ 9__ 10__ 11__
12__ 13__ 14__

Name_____ Position_____

Company_____

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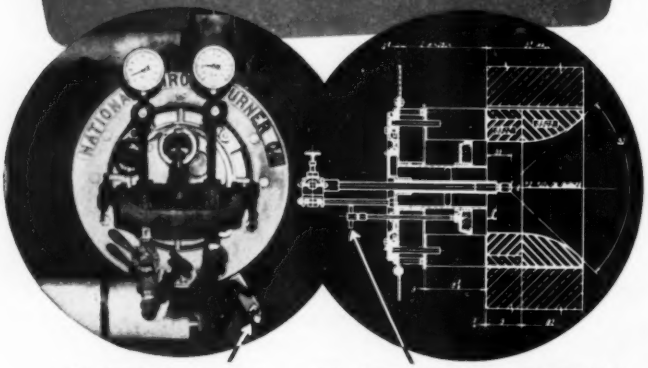
DUAL CONTROL MEANS *Economy...*



(1) Control for Air Vanes (2) Control for Refractory Faced Disk

with

NATIONAL AIROIL Universal Registers

AND TYPE "S-A" OIL BURNERS

. . . and *economy* means that you get *better performance* with NATIONAL AIROIL Universal Registers because they have a *dual feature* for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk control. Both adjustments can be made while the Type "S-A" Oil Burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil.

Universal Registers with Type "S-A" Burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. *Write for Bulletin 51.*

PRODUCTS

- Oil Burners and Gas Burners for industrial power, process and heating purposes
- Steam Atomizing Oil Burners
- Motor-Driven Rotary Oil Burners
- Mechanical Pressure Atomizing Oil Burners
- Low Air Pressure Oil Burners
- Automatic Oil Burners, for small process furnaces and heating plants
- Gas Burners
- Combination Gas and Oil Burners
- Fuel Oil Heaters
- Fuel Oil Pumping and Heating Units
- Furnace Relief Doors
- Air Intake Doors
- Observation Ports
- Special Refractory Shapes

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: 1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

Industrial Oil Burners, Gas Burners, Furnace Equipment

More POWER NEWS

Begins on page 148

Geo-Thermic Power Stations in Italy

ROME—*McGraw-Hill World News:* Chairman of the A.G.I.P. (a State concern for the exploitation of national resources of liquid fuel), announced Italy will be able to produce 3 billion kwh of geo-thermic power a year—all derived from the Lardarello district in Tuscany—once power station No. 3 at Lardarello, starts operating.

There are still far larger sources of natural steam to be exploited in Italy such as the Isle of Vulcano belonging to the Aeolian group, where recent drillings for a well produced steam equal to and even better than that of Lardarello, the Campi Flegrei, which presents the same features typical of the endogenous areas, plus some parts of the Tuscan coastline, the country around Viterbo, the Euganean Hills and some localities in Sicily.

International Nickel Co has prepared a new sound color film called *Corrosion in Action.* It shows how corrosion causes an estimated $6 billion annual loss in industry and elsewhere. Also shows how to avoid or control this damage by using corrosion-resistant materials, developing new alloys, using electric currents to provide cathodic protection, etc. Bookings can be arranged through the Corrosion Engineering Section, International Nickel Co, Inc, 67 Wall St, New York 5, N. Y.

Philip W Swain, editor of POWER, was recently elected a fellow of the **ASME,** for distinguished achievements in the field of mechanical engineering.

Arizona's three major utilities, **Central Arizona Light and Power, Salt River Valley Water Users Assn,** and **Arizona Edison,** are jointly studying plans for a proposed 120,000 to 180,000 kw steam generating plant to be built in central Arizona at a cost of $15,000,000 to $22,500,000. Location of the plant hinges principally on plans of the Magma Copper Corp. They will require a vast amount of power for operation of the San Manuel copper mine under development near Mammoth, 60 mi northeast of Tucson in Pima County.

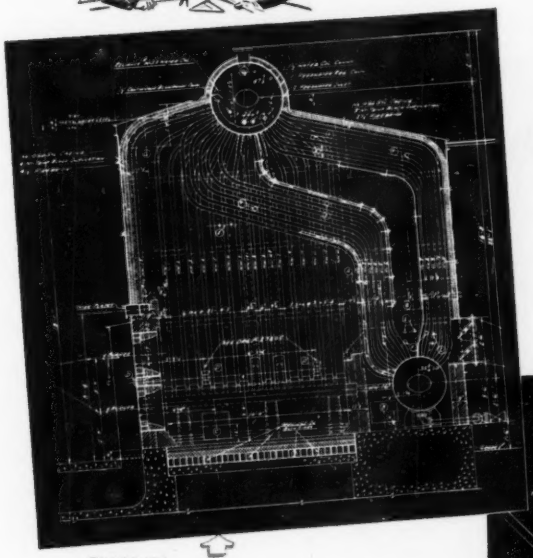
A warning against unjustified or unproved claims for so-called combustion catalysts has been issued by the Technical Advisory Board of **Bituminous Coal Research, Inc,** the national research agency of the bituminous coal industry. It states that some users of coal are being persuaded to make expensive installations and trials of special treating materials or catalytic agents which are claimed to reduce smoke, soot, ash and clinkers and to increase efficiency. Bituminous Coal Research's experience to date indicates the use of such materials in economically feasible quantities does not accomplish the claimed results and their use is unjustified with coal.

Industry Approved

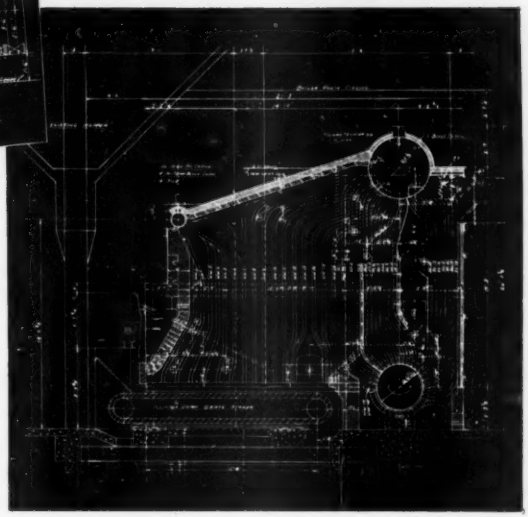
Two-Drum

STEAM GENERATORS

by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

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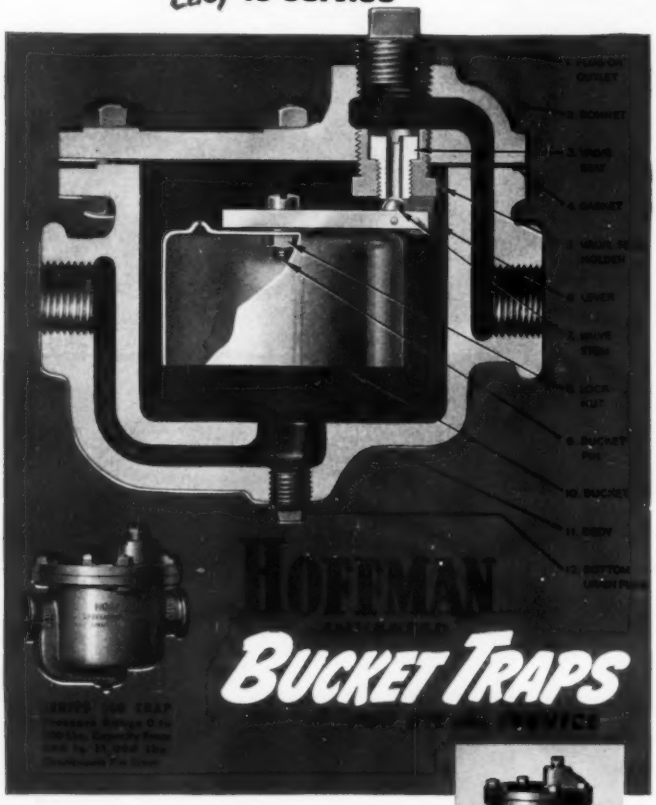
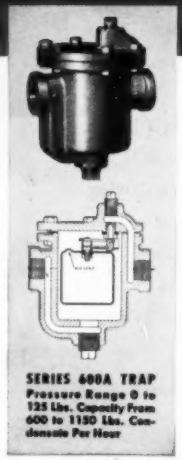
This simple mechanism is *Easy* to install... *Easy* to service





HOFFMAN Bucket Traps operate intermittently and are particularly applicable to draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. They are easily inspected, cleaned and serviced by merely removing the cover assembly.

Straight-through pipe connections permit close-to-floor installation.

All working parts are connected to the bonnet and are removable with it for service without breaking pipe connections.

These are features of design appreciated by the maintenance man in saving man-hours when manpower is costly and scarce.

Hoffman Bucket Traps are adjustable to a wide choice of pressures, simply by changing valve seats. Send today for full information, no obligation.

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BOOKSHELF

Electric Machinery. *By A E Fitzgerald and Charles Kingsley Jr, associate professors of electrical engineering, Massachusetts Institute of Technology. 6x9 in., 702 pp, $8.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

The author's approach in this text, intended for undergraduate electrical engineers, is to highlight the principles common to all rotating electrical machinery, then apply these principles to the various specific equipment. Among the machines discussed are the conventional dc motors and generators plus synchronous, polyphase induction, single-phase, *Amplidynes, Rototrols* and *Selsyns.* Transformers are included because of their similarity in principle to the above-mentioned equipment.

The questions of how machines work and in particular how torque is produced are thoroughly examined. Specific applications of principles and methods of analysis are illustrated with examples; complete solutions are distributed throughout.

Exhaust Hoods *(1952—2nd edition). By J M Dalla Valle, Prof of chemical engrg, Georgia Institute of Technology, 141 pp, 6¼x9¼ in., 127 illust, 30 tables, fabrikoid. $3.50. The Industrial Press, 148 Lafayette St, New York 13, N. Y.*

This book gives comprehensive information on the flow of air around and into openings, hoods and slots in exhaust ventilating systems. All phases of hood, booth and slot design are covered.

Four chapters cover various aspects of theory, including flow of gases, velocity characteristics of canopy hoods and criteria for determining hood effectiveness. Other chapters cover booth-like structures, grille openings, woodworking machinery, hood design calculations, entrance losses and essentials of good construction. Sample problems, with solutions worked out in detail, are given in a chapter devoted entirely to this matter.

Modern American Engineers. *By Edna Yost. 182 pp, 8x5½ in., $2.50. J B Lippincott Co, East Washington Sq, Philadelphia, Pa.*

An interesting collection of short, readable biographies of outstanding engineers. This book has been prepared primarily for young people who are in the throes of choosing a lifetime occupation. But the treatment is in thoroughly adult fashion. The dozen men covered in this book came from widely varying backgrounds and all achieved eminence in their own branches of engineering.

The men in the book are R E Doherty, engineering educator, originator of the Carnegie Plan of education; R E Flanders, mechanical engineer, now in the U. S. Senate; A E Morgan, civil engineer, former chairman of TVA; V Bush, electrical engineer, director of the Office of Scientific Research and Development during World War II; S Turner, mining engineer, former director of the U. S. Bureau of Mines; J

Here is a typical example of Mead-Morrison speed in handling coal.

The illustration shows a Mead-Morrison Travelling Unloading Tower with conveyor stacker boom at a large New England steam generating station. Its 4-ton coal grab bucket discharges 10,000-ton colliers at a breakdown rate in excess of 700 tons per hour.

There are over seventy-five unloaders of this type in operation along rivers and harbors from Maine to Florida.

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UNLOADERS AND BRIDGES

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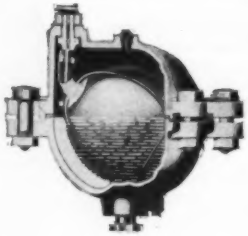

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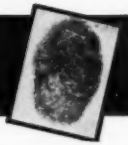

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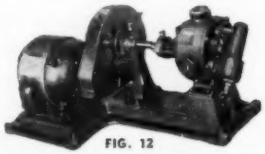

FIG. 12

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More BOOKSHELF

Begins on page 210

B Davidson, agricultural engineer, pioneer in establishing engineering in farming activities; H B Maynard, industrial engineer, specialist in industrial management; O Singstad, civil engineer, authority on vehicular tunnels; J B Suman, petroleum engineer, leader in increasing percentage of oil recovery; C G A Rosen, research engineer, inventor of fuel injection equipment for diesel engines; S W Sparrow, automotive engineer, vice president of Studebaker Corp; H A Wheeler, radio and television engineer, consulting radio physicist and owner of Wheeler Laboratories.

All technical men should spend some pleasant hours in reading this well-written and informative book. They will gain a new breadth of vision of the immense scope of their profession.

Basic Engineering Thermodynamics. *By Vincent W Young, consultant in thermodynamics. 558 pp, 6½x9¼ in., illust, tables, fold-out charts, $6.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This text aims to give full coverage of thermodynamics for use with classes of mechanical engineering undergraduates. The conventional range of subjects in engineering thermodynamics is discussed, including applications to steam and gas turbines, jet engines, refrigeration cycles, fluid flow, combustion and heat transfer.

The front part of the book contains a demonstration of the reversible process used as the criterion for maximum work output of cycles. This allows use of this concept throughout the theory development. Following modern practice the book includes a chapter on heat transfer and those chemical processes of interest to the mechanical engineer.

Elementary Heat Power (*Second edition*). *By H L Solberg, O C Cromer and A R Spalding, all Purdue University Dept of Mechanical Engineering. 624 pp, 6x9 in., illust, tables, $6.50. John Wiley & Sons, Inc, 440 Fourth Avenue, New York 16, N. Y.*

This edition has been expanded by about 100 pages to include discussion of the general energy equation as the first law of thermodynamics and its application to power plant equipment. Added material summarizes basic concepts and definitions.

Additional material includes the use of entropy, Mollier diagrams for steam and ammonia, gas tables for air, for solving problems. Many of the problems have been revised and new ones added to expand the coverage of the field.

This text is designed for use in a course on elementary power machines in advance of a thorough course in thermodynamics.

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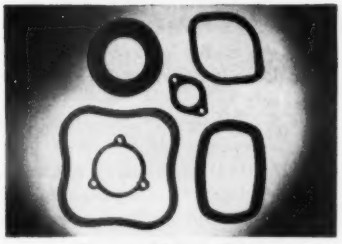

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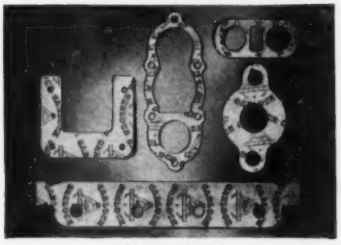

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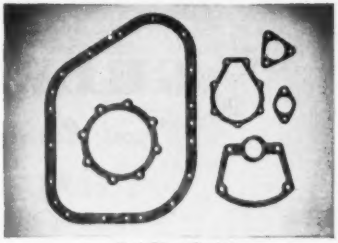

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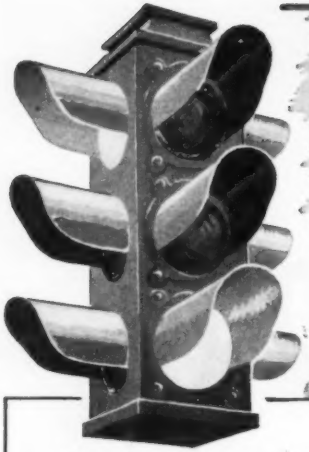

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The same engineering talents and the same careful construction go into the many stack supporting draft fans we have designed for the so-called "packaged" boilers. In some ways, engineering faces more difficult design problems because of the utmost efficiency required in a relatively small space.

Green Stack Supporting Draft Fans are practical, too. They are readily accessible for inspection and maintenance. Shafts and wheels are removable endwise without disturbing the stack or other structural members.

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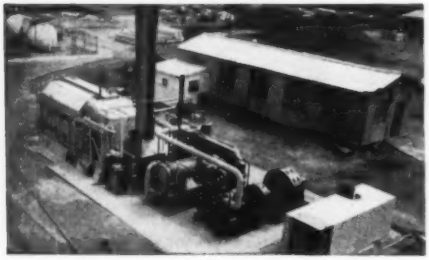

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► OUR SHOP WAS SHORT of compressed air so we bought three new compressors. The day they arrived I got out tools and equipment to build foundations recommended by the manufacturer. Just then the boss came in.

"What are you doing?" he asked. I told him. "We can't wait for those foundations to harden," he said. "Run the compressors on the skids they were shipped on. Have them ready by morning."

I argued a little with him but he wouldn't listen. So against my better judgment I turned the maintenance crew to and they spent all night getting the compressors ready.

Next morning the boss broke an empty soda bottle on one of the machines and pulled the three switches. The compressors started smoothly but the floor vibrated severely. I held my breath but nothing went wrong.

We ran the three units that way for about a month until one morning trouble really started. One compressor broke loose from the floor, snapped its piping and cut a gash in a nearby air tank.

The boss came running to see what had happened. He yelled for awhile and then said, "Next time don't give in so easily. Argue with me until I understand what you're trying to say."

From that time on we've always installed machines the way the manufacturer recommends. As they say, it's better to be safe than sorry.

FRED LETTINO *Astoria, N. Y.*

• What is your "biggest boner?" We'll pay ten dollars for each one we publish.

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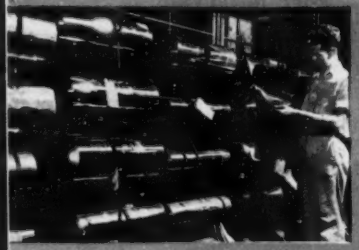

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Sudden overpressure . . . and an expensive pressure vessel or piece of processing equipment is damaged – perhaps beyond repair. If that's all you're lucky. Other equipment may be lost, too...still worse, people may have been injured critically, often fatally.

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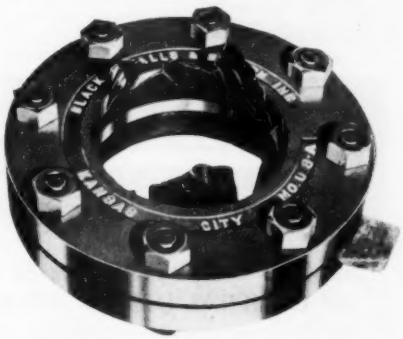
Regardless of your pressure application – air, gas or liquid – bland or corrosive, BS&B has the code-accepted Safety Head for you. Get the facts, get safety, get a BS&B Safety Head. Write for catalog giving complete details.



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you'll find top management and operating personnel interested in adequate plant and personnel protection. When that pressure results in overpressure in vessels and lines, such industries as chemical, refrigeration, power, petroleum production, processing and handling are looking to BS&B Safety Heads as the simplest, the surest, the most successful device for primary or secondary relief from critical pressures.

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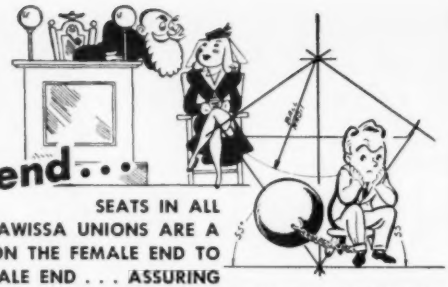

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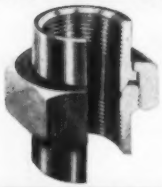

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Begins on page 163

B16 **POWER FUSES**—Type BA *De-Ion* boric acid fuse, type DBA drop-out fuse, type BAL current-limiting fuse. 6-page bulletin B-5469 gives ratings, construction, operation, photos. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B17 **INDUSTRIAL CAPACITORS**—*Stabelex D* type. Capacities .00005 to 12.0 Mfd at 600 v, dc, .05 to 25.0 Mfd at 400 v, dc. 8-page catalog 1117 gives dimensions, uses, characteristic curves. Industrial Condenser Corp, 3243 N California Ave, Chicago 18, Ill.

MAINTENANCE MATERIALS

B18 **ASBESTOS PRODUCTS REFERENCE**—Lists 800 building materials and industrial products obtained from asbestos, asphalt and magnesia. Manual gives Army, Navy, MIL, Federal, ASTM, and other specifications, plus their corresponding product. Philip Carey Mfg Co, Dept FRM, Cincinnati 15, Ohio.

B19 **COOLANT FILTER**—*Web-O-Matic* self-cleaning type for individual machine tools or small central coolant systems. Capacities 50 to 400 gpm. 4-page bulletin gives construction, operation, photos. Honan-Crane Corp, 200 Superior Ave, Lebanon, Ind.

B20 **RING PACKING**—For piston and rod assemblies, pressures to 15,000 psi. *Palmetto G-T* ring eliminates packing material extrusion 8-page bulletin MP-68 gives design features, dimensions, applications. Greene, Tweed & Co, North Wales, Pa.

B21 **PACKING**—Sheet and ring types. Two 4-page bulletins give specifications, service recommendations. *Walkerite* sheet packing for use up to 1000 psi, 1000 F; *Shaflex* packing for shallow stuffing boxes comes in sets of V-shaped rings with male and female adapters, any size from 3/16 in. up. James Walker Packing Co, Inc, 96 Liberty St, New York 6, N. Y.

B22 **PREVENTIVE MAINTENANCE**—For turbines, generators, switchboards, motors, controls, etc. 28-page booklet B-5477 gives frequency of inspection and care, discusses general preventive maintenance program. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B23 **ANTI-RUST PAINT**—For metal surfaces. 4-page bulletin L-4285 describes action and uses of PCA black and clear paints. Paint Corp of America, Fidelity Bldg, Cleveland 14, Ohio.

B24 **PROTECTIVE COATINGS** — For concrete and steel. Proof against acids, alkalies, alcohol, oil, salts, water. 4-page bulletin describes *Prufcoat* products, applications. G Russell Hersam, Gen Sales Mgr, Prufcoat Laboratories, Inc, 50 E 42nd St, New York 17, N. Y.

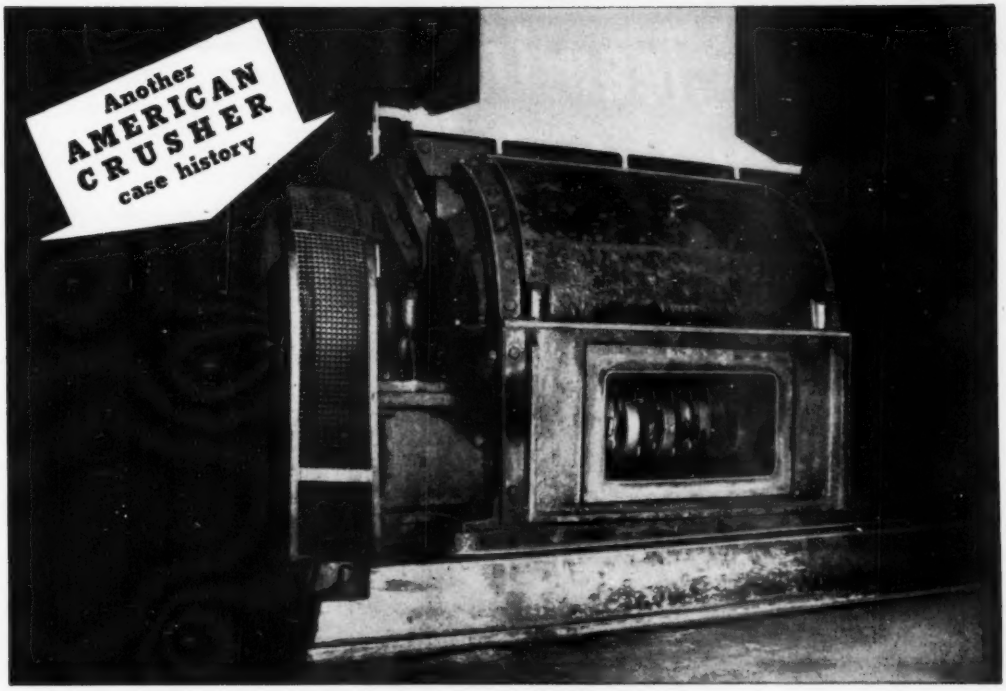
B25 **CONCRETE HARDENER** — And dustproofer. *Lapidolith* guaranteed to prevent progressive disintegration and dusting. 6-page bulletin and 4-page technical data guide No. 1 gives uses, test results. Dept P-1, Building Products Div, L Sonneborn Sons, Inc, 80 Eighth Ave, New York 11, N. Y.

MATERIALS HANDLING

B26 **PROGRESSIVE MECHANIZATION** — *More Power to America* presentation. 16-page bulletin GEA-5789 shows five stages of mechanization, suggests questions to indicate how your operations can be improved. General Electric Co, Schenectady 5, N. Y.

B27 **BULK-FLOW CONVEYORS**—For granular, flaky, crushed, ground or pulverized materials. Enclosed endless chain construction moves in horizontal, inclined or vertical direction. 28-page booklet No. 2475 gives photos, applications, selection data. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

B28 **FORK LIFT TRUCKS**—Gasoline and diesel powered models, 3000 and 4000 lb capacities. Three 4-page bulletins No. 1579, 1580, 1581 give di-



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Originators and Manufacturers of Ring Crushers and Pulverizers

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Masoneilan No. 11

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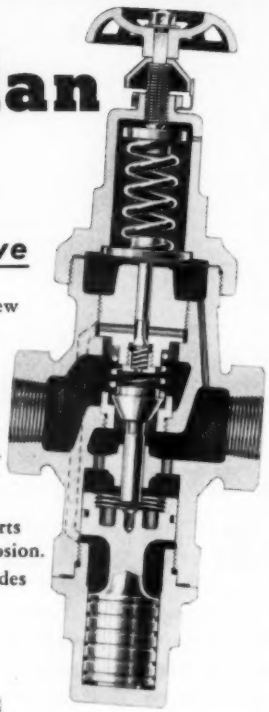

That's what users tell us about this new better-than-ever Masoneilan Pilot Operated Steam Pressure Reducing Valve. Service records show maintenance consists of little more than keeping the moving parts clean.

What's more, it's the most *accurate, dependable* steam reducing valve we've ever offered.

More sensitive, its superfinished parts practically eliminate sticking or corrosion.

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Sturdier construction prevents possibility of damage.

All working parts may be removed and replaced with the valve in the line. Integral pilot valve simplifies assembly.

Available for initial pressures up to 250 psi reduced to any pressure from 10 to 90 psi or 75 to 225 psi. Sizes ¼″ to 2″ in bronze; 2½″ to 4″ iron; or ½″ to 3″ steel.

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More FREE BULLETINS

Begins on page 163

mensions, specifications, operating data. The Buda Co, Harvey, Ill.

B29 **FOUNDRY MECHANIZATION** — Case histories, foundry layout drawings and installation photos. 34-page booklet No. 2439 shows mechanization in molding, pouring, cooling, sand preparation. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

MECHANICAL TRANSMISSION

B30 **OVERLOAD RELEASE** — For *torque-arm* speed reducer. *Trimatic* unit loosens belts, cuts off power and gives warning. 4-page bulletin A-616 gives photos, dimensions, prices. Dodge Mfg Corp, Mishawaka, Ind.

B31 **LIQUID DRIVES** — Traction-sheave, traction flexible coupling, and traction-hub mounted designs for ½- to 50-hp motors. 8-page bulletin 6020 gives construction, dimensions, uses, photos. Liquid Drive Div, G E Nelson Co, Holly, Mich.

B32 **POWER APPLICATION** — House organ *Production Road* presents uses of industrial friction and hydraulic drives in basic industries issue. 24-page booklet, issued regularly. Twin Disc Clutch Co, Racine, Wis.

METERS AND INSTRUMENTS

B33 **WATTHOUR METERS**—Guide for selection and installation. 52-page pocket size booklet GET-2376 has simplified selection tables, descriptions of meters, wiring diagrams of watthour and demand meters. General Electric Co, Schenectady 5, N. Y.

B34 **DIFFERENTIAL TRANSFORMERS**—Measure straight line motions. 12-page bulletin R-51 explains operation, characteristics, uses. Photos, wiring diagrams. Automatic Temperature Control Co, 5200 Pulaski Ave, Philadelphia 44, Pa.

B35 **TEMPERATURE MEASUREMENTS**—In central stations. 4-page data sheet No. 9.1-11 discusses thermocouples and continuous balance type potentiometers, illustrates basic types for steam generating stations. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B36 **POTENTIOMETER** — Two-second high-speed *ElectroniK* strip chart type. Operates on continuous balance principle. 2-page specification sheet 179 gives specifications. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B37 **SURGE COMPARISON TESTER**—Locates insulation faults and winding dissymmetries in motors, generators, transformers, coils. 8-page bulletin DB 85-960 describes mobile and portable models, operation; photos, specifications. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B38 **METERS**—For industrial liquids. 20-page bulletin gives specifications, selection data on meters from ⅝ to 6 in., 2 to 1000 gpm, handling cold, warm or hot water, chemicals and industrial liquids. Neptune Meter Co, 50 W 50th St, New York 20, N. Y.

B39 **HIGH-PRESSURE GAGES** — Working pressures to 2000 lbs at 300 F, 1000 lbs at 800 F. Gage glass is 1 in. thick. 4-page bulletin 23-A gives specifications, prices, parts lists. The Inferno Co, P O Box 1138, 115 Ricou St, Shreveport, La.

B40 **TACHOMETER INDICATORS** — Three range, single head, fixed type. 2-page data sheet 42P. Direct measurements from 1 to 100,000 rpm. Description, selection, use. Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

B41 **HAND TACHOMETERS** — Single range instrument measures speeds from 300 to 4000 rpm; triple range units from 25 to 30,000 or 30 to 40,000 rpm.

"Our *Powermaster* Boilers are dependable, efficient, easy to service, and economical to operate"

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Plant Engineer
Blue Bird Silk Mfg. Co.

Alfred J. Sidler
Plant Manager
Blue Bird Silk Mfg. Co.

20% Saving in Steam Cost at York, Pa. Manufacturing Plant

William H. Wagner, Plant Engineer of the Blue Bird Silk Manufacturing Company, knows the problems of generating high-pressure steam 24 hours a day, 365 days a year. And he knows how serious it can be for a busy manufacturing plant if there is trouble or failure in the boiler room. That's why, two years ago, the company replaced their old-fashioned coal-fired boilers with two 200 h.p. POWERMASTER packaged automatic boilers, burning #6 (Bunker C) oil. Here is what they found:

- The cost of producing steam for processing and heating dropped 20%.
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- The POWERMASTERS respond very rapidly to variations in load.
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Little wonder that Alfred J. Sidler, Plant Manager, says, "If we had it to do over again, we would certainly buy POWERMASTERS."

No other packaged automatic boiler gives you *all 3 advantages of the Powermaster:*

1. SAVE FUEL—because the special *Powermaster* burner design gives you top efficiency when operating anywhere between 30% and 100% of capacity.
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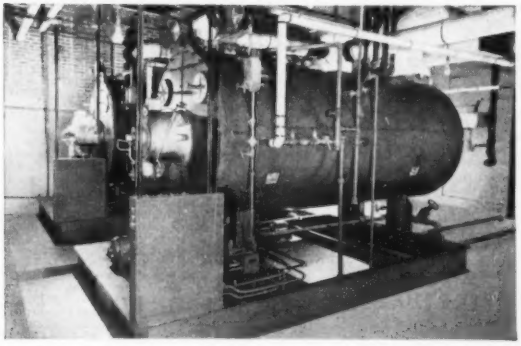
3. CHANGE FROM OIL TO GAS (or gas to oil) in just a few minutes. Burn light oil, heavy oil, or gas—whichever is cheaper. You no longer need depend on one source of fuel supply.

Write for this Catalog

To get complete information about this modern packaged automatic boiler for steam or hot water, write for *Powermaster* Bulletin 1218. We'll be glad to put a copy in the mail for you.



These 200 h.p. POWERMASTER packaged automatic boilers have been operating round-the-clock for more than two years at the Blue Bird Silk Manufacturing Company, York, Pa. Burning #6 oil, they produce a total of 13,800 pounds of steam per hour.

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In sizes to 500 h.p.; pressures to 250 psi.

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MUNDET 85% MAGNESIA INSULATION provides maximum strength and resistance to vibration. Extra durability is built into this insulation. In pipe covering and blocks, it is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering and Blocks.

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INSULATION FOR HIGH & LOW TEMPERATURE

More FREE BULLETINS

Begins on page 163

2-page bulletin gives specifications, construction. O Zernickow Co, 15 Park Row, New York 38, N. Y.

B42 SCALES—28-page condensed catalog No. 11 contains selection of 1000 standard scales weighing from 1/64 oz to 400 tons. Beam indication, tape-drive dial, weightograph projection, teleprint electronic remote weight recorder, and other types. Specifications, photos. Howe Scale Co, Rutland, Vt.

PIPING, VALVES, FITTINGS AND SPECIALTIES

B43 PIPING DESIGN—Reprint of article "How to Use Scheduled Numbers in Power Piping Design" from *Heating Piping and Air-Conditioning*. 8 pages, with charts, tables. Bulletin 515A. Taylor Forge & Pipe Works, P O Box 485, Chicago 90, Ill.

B44 PIPE STRAINERS—Self cleaning units in ⅛- to 3-in. sizes. 4-page bulletin 252 gives specifications, prices, applications. Wm J Gleason Jr, Steam Specialties Div, V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio.

B45 PUMP AND CHECK VALVES—For pumps, compressors, engines. Two 8-page bulletins give photos, dimensions, ordering instructions for all standard units. Durabla Mfg Co, 114 Liberty St, New York 6, N. Y.

B46 REGULATING VALVES—Double-seated diaphragm type for use with control instruments. Class DV in 1½-to 10-in. sizes. 2-page bulletin 513 gives features, photos, dimensions. Leslie Co, 367 Delafield Ave, Lyndhurst, N. J.

B47 HOSE ASSEMBLIES — Vari-purpose, hydraulic, paint and solvents spray, lubrication types. 8-page bulletin 3-1952 describes hoses and couplings. Dimensions, photos, applications. Carlyle Rubber Co, Inc, Dept Z-4, 64 Park Place, New York 7, N. Y.

B48 STEAM PURIFIER — For small lines, ½- to 2-in. sizes. Unit removes entrainment from live or exhaust steam, vapors and air. 6-page bulletin 500 gives photos, dimensions, uses. V D Anderson Co, Purifier Div, 1935 W 96th St, Cleveland 2, Ohio.

B49 STEAM TRAPS — Bronze, semi-steel and cast steel bodies, sizes ¼ to 2 in., pressures from vacuum to 300 lbs. 12-page bulletin 152 gives capacities, dimensions, piping diagrams, selection data. W H Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa.

B50 VALVES — Needle, globe, ball check, relief and plug valves formerly made by Parker Appliance Co. 40-page catalog lists valves from ¼ to 1 in., for pipe or tube connection. Republic Mfg Co, 1930 W 77th St, Cleveland 2, Ohio.

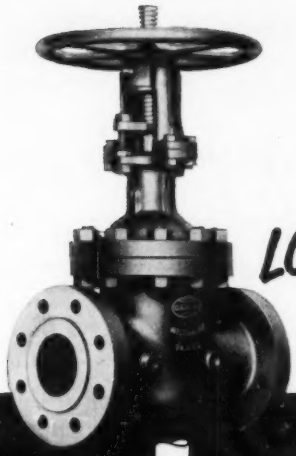
B51 IRON VALVES—Gate, globe and check types, also fire line valves. 4-page bulletin V-405 has cut-away views, dimensions, specifications. Fairbanks Co, 393 Lafayette St, New York 3, N. Y.

B52 EXPANSION JOINTS — *FlexoDisc* type in 4 to 30-in. standard pipe sizes, 75, 150, 300 and 400 lb ratings. 8-page bulletin 51 gives photos, descriptions. Croll-Reynolds Engineering Co, Inc, 17 John St, New York 38, N. Y.

B53 GAGES AND VALVES — Heated and cooled types, external and internal tube models. 4-page folder, unit 179, gives photos, specifications, dimensions. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

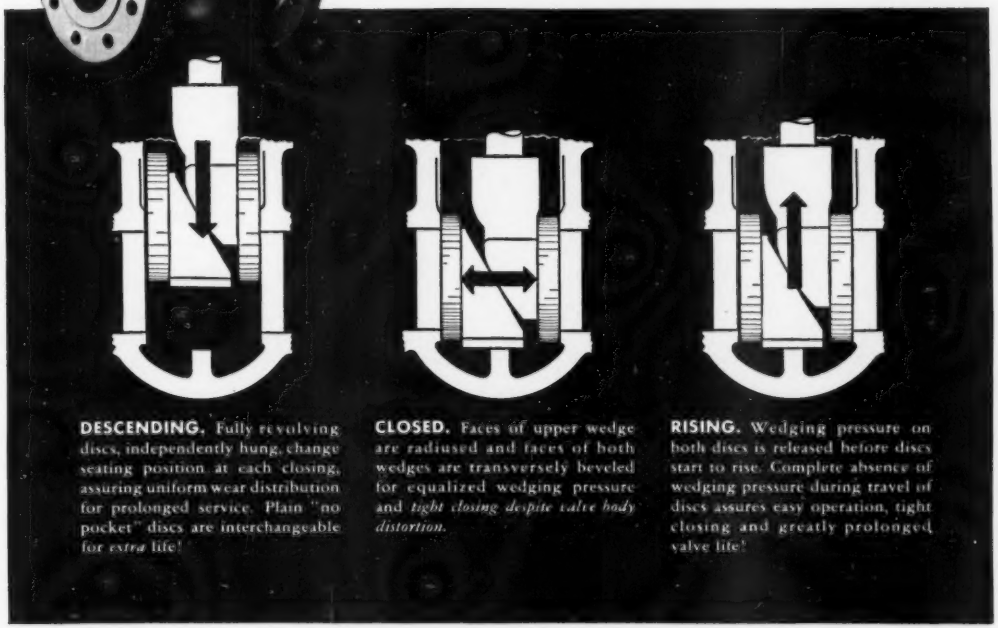
B54 CYLINDER-FINISH TUBING — Uniform controlled bore tolerances. 4-page bulletin R7 describes sizing process, gives tolerances. Tube Reducing Corp, Wallington, N. J.

B55 CORROSION-RESISTANT VALVES—Nordstrom line, bolted or screwed gland, *hypreseal*, multiport and two-bolt types. Pressures from vacuum to 15,000 lb test, sizes from ½ to 34 in. 36-page bulletin V-217 gives



Look how you gain LONGER, TROUBLE-FREE VALVE LIFE

with Darling revolving disc gate valves*



DESCENDING. Fully revolving discs, independently hung, change seating position at each closing, assuring uniform wear distribution for prolonged service. Plain "no pocket" discs are interchangeable for *extra* life!

CLOSED. Faces of upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressure and *tight closing despite valve body distortion.*

RISING. Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation, tight closing and greatly prolonged valve life!

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These unique valves are available in iron, bronze, steel, special corrosion-resistant alloys and combinations, and in a broad range of sizes, for all kinds of normal and unusual services in pressures up to 1500 pounds. Before you buy gate valves of *any* type, find out what you stand to gain by using the proper Darling valves. Simply outline your service requirements and ask for a free, descriptive bulletin.

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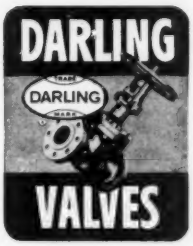
Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario.



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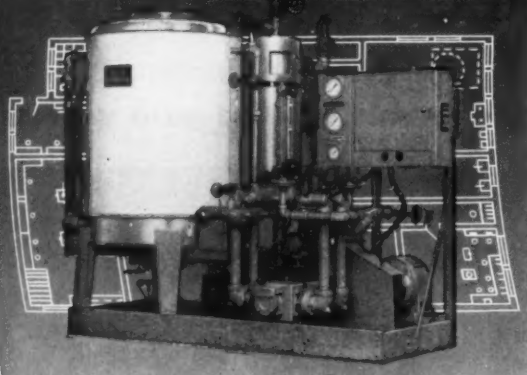

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Plan your steam plant for long range economy and realize immediate savings on installation and operating costs.

The Clayton *Forced Recirculation* Steam Generator...in sizes from 15 to 100 h.p., and equipped to burn gas or oil, or both...is a compact, self-contained steam plant ready to install and operate as it is delivered. No accessories to buy. No stack, bricking or foundations to install. Move into place; connect fuel and water lines, electricity and vent, and the Clayton generator is ready to operate. Occupies 30% to 70% less space than conventional boilers of same capacity.

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Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

More FREE BULLETINS

Begins on page 163

photos, dimensions, prices. Rockwell Mfg Co, 400 N Lexington Ave, Pittsburgh 8, Pa.

PUMPS

B57 **PUMP INSTRUCTION BOOK**—For installing, operating, repairing single-stage single-suction centrifugal pumps. 24 - page bulletin 08X7813 contains diagrams, parts lists, trouble-shooting information. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B58 **PUMP INSTRUCTION BOOK**—For installing, operating, repairing multi-stage centrifugal pumps. 48-page bulletin 08X7780 gives complete information. Photos and diagrams of all parts. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B59 **TURBINE VANE PUMPS**—Close- and flexible-coupled electric drive units for clear water and vaporous liquids. Capacities to 58 gpm at 3500 rpm, heads to 800 ft. 12-page booklet B-2205 has diagrams, selection data, capacity charts. Peerless Pump Div, Food Machinery & Chemical Corp, Los Angeles 31, Calif.

B60 **GENERAL PURPOSE PUMP** — Horizontal centrifugal split-case, type AS capacities to 750 gpm, heads to 230 ft. 8-page bulletin B-1350 gives features, parts list, dimensions. Peerless Pump Div, Food Machinery & Chemical Corp, Los Angeles 31, Calif.

B61 **SELF-PRIMING PUMP** — Single-stage, single-suction volute type with closed impeller. Priming done by small variable capacity, vane type positive displacement pump mounted inside main housing. 4-page bulletin has diagrams, dimensions. Gilbert & Barker Mfg Co, West Springfield, Mass.

WATER TREATMENT

B62 **WATER CONDITIONING DATA BOOK**—Hydraulics, impurities in water, chemical conversions, saturated steam, boiler feedwater makeup requirements, specific gravities, etc. 116-page book has many charts, curves, tables, revised from earlier edition. Permutit Co, 330 W 42nd St, New York 36, N. Y.

B63 **HOT PROCESS SOFTENERS**—For treating boiler feedwater. 32-page booklet 2341 describes conventional and sludge-blanket types, with and without built-in deaerating equipment, also two-stage hot lime and zeolite equipment. Photos, diagrams. Permutit Co, 330 W 42nd St, New York 36, N. Y.

B64 **SCALE AND CORROSION CONTROL**—By organic methods. For domestic, boiler, cooling and pasteurizing waters, steam and return condensate, brines. 40-page booklet discusses various control methods. Gives charts, properties and uses of chemicals. D W Haering & Co, Inc, P O Box 6037, San Antonio, Texas.

B65 **COOLING TOWERS** — Induced, forced and natural draft types. 8-page bulletin gives photos, specifications, capacities. Water Cooling Equipment Co, New Hampshire Ave and Weber Rd, St. Louis 23, Mo.

WELDING

B66 **BRAZING MANUAL**—For shapes, sheet, castings, tubing and assemblies of copper, brass, steel, aluminum, cast iron. 16-page bulletin explains the important parts of the brazing operation, gives general brazing techniques. All-State Welding Alloys Co, Inc, White Plains, N. Y.

★ **WELDING STEEL CASTINGS**—Practices recommended by Steel Founder's Society of America. 40-page booklet discusses welding methods, electrodes, procedure for carbon-steel and low-alloy castings. Tables, diagrams. ★Request direct, on business letterhead. Tempil Corp, 11 W 25th St, New York 11, N. Y.

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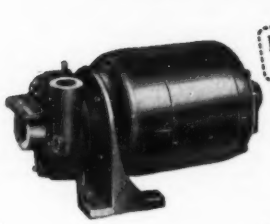
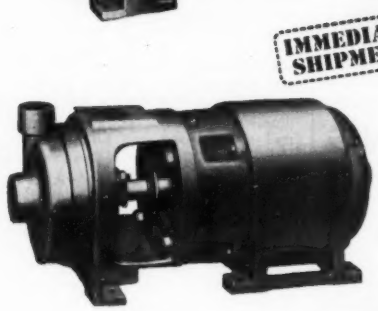
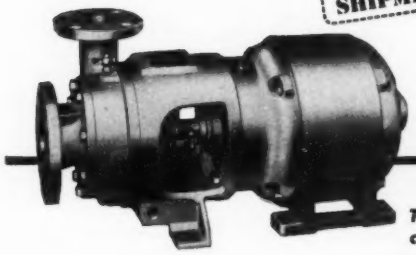
...OF I-R MOTORPUMPS







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Availability of Jefferson Unions in all types means that these fittings will definitely effect savings in time, labor and materials in making up pipe joints. Maintenance savings, too, can be assured because piping systems can be made up with fewer joints . . . spherically-ground, easily-made-up joints which remain tight and require no further attention.

The Jefferson line includes also unions with all-iron seats, AAR 300#, Enduro 300#, Excel 250# and Master 150# unions.

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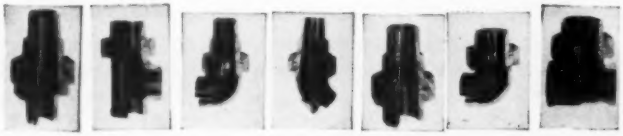
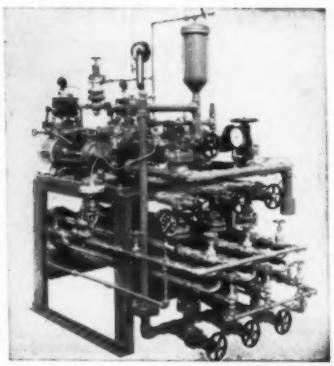


LOCKETT FUEL OIL PUMPING AND HEATING SETS *Custom Built*



The compact, high-pressure unit illustrated consists of two Worthington Duplex Steam Pumps and three Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

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Contracting Mechanical Engineers

NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

APPOINTMENTS

New Corporation Executives

Dr Paul D Merica is elected president of the International Nickel Co of Canada, Ltd, and its U.S. subsidiary, **International Nickel Co, Inc,** succeeding Dr John F Thompson who continues as chairman of the board of both organizations. In the U.S. subsidiary, Walter C Kerrigan becomes vice-president and general sales manager, responsible for both nickel and mill products sales, with R L Larson assistant vice-president and assistant general sales manager. Theodore H Dauchy, Richard A Cabell and John A Marsh are also promoted to assistant vice-presidents.

At **Westinghouse Electric Corp,** W W Sproul becomes vice-president in charge of the general industrial products group of divisions; L B McCully is vice-president in charge of the E Pittsburgh divisions; H E Seim, vice-president in charge of the Sturtevant division, and the Bryant Electric Co, a wholly-owned subsidiary.

R W Owens becomes senior vice-president of **Elliott Co.** The board of directors of **Electric Products Co** elects Gordon J Berry president. L A Dixon and Jas E Ashman are new executive vice-presidents at **Rockwell Mfg Co.**

Two divisions of **Union Carbide and Carbon Corp** have new presidents: Thomas D Cartledge at Linde Air Products Co, and Howard S Bunn at Bakelite Co.

Kenneth A Wright becomes vice-president and central district manager of **Johnson Service Co,** succeeding Oscar G Ward, who died recently. At **Union Electric Co of Missouri,** R F Moody becomes vice-president and general manager, Dudley Sanford vice-president and assistant general manager; G P Gamble, vice-president, heads the transmission and distribution dept.

Ahlberg Bearing Co appoints Ernest J Klimczak chief engineer, secretary of the company, and member of the board of directors. Leonard L Youell becomes vice-president of **Stone & Webster Canada Ltd.** Wallace L Howe becomes director of research and development at **Norton Co,** following resignation of Dr Samuel S Kistler, director of research.

Laclede-Christy Co elects these officers: J D Streett, president; A B Agnew, J L Cummings and L C Hewitt, vice-presidents; W W Shipley, vice-president and treasurer; E J Williams, controller and secretary.

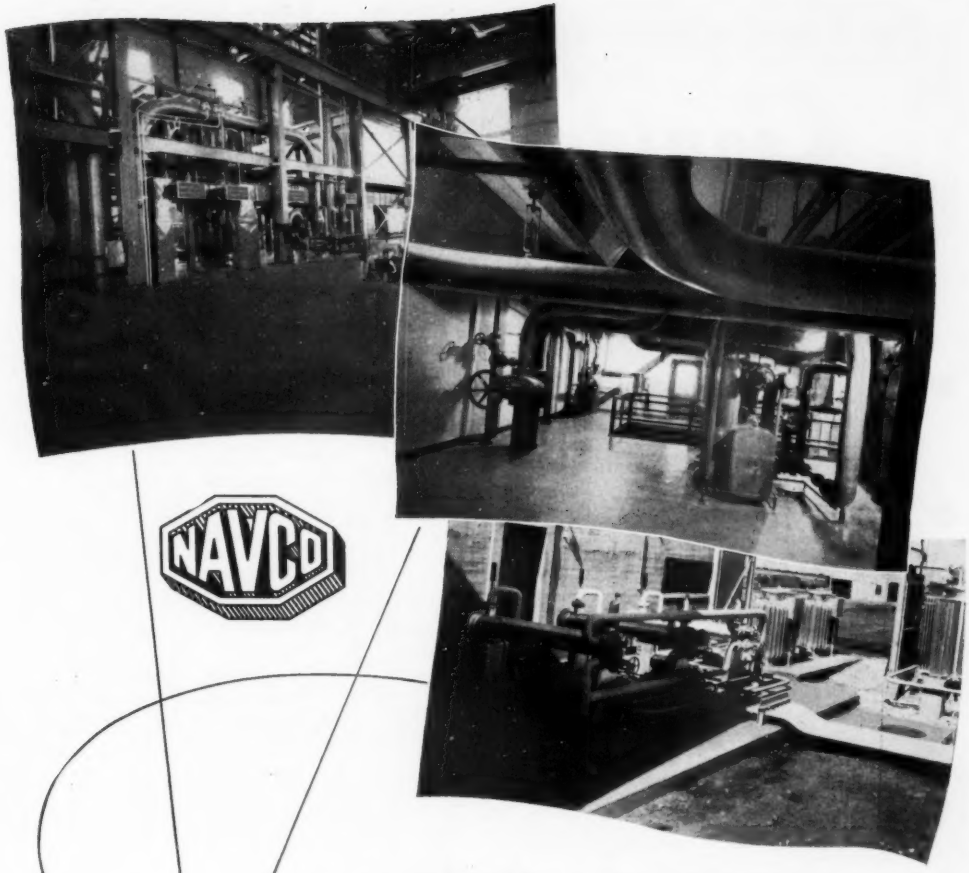
At **Gar Wood Industries, Inc,** H H Hippler becomes assistant director of sales and advertising; R F Whitworth succeeds him as manager of the branch division. Ross Miller is vice-president and general manager of National Lift Co, Gar Wood subsidiary.

General Motors Corp elects James E Goodman vice-president and a member of the administration committee. New chairman of the board of trustees for **Southwest Foundation for Research and Education** is Dale Dorn.

New Operations Executives

James H Elkus becomes assistant manager, and W J Kalmeyer works manager, Blaw-Knox division of **Blaw-Knox Co.**

At **Westinghouse Electric Corp,** H R



NAVCO

Installations in Central Power Stations assure Absolute Dependability

FOR almost half a century Navco has specialized in the fabrication and erection of Piping Systems for the highest operating conditions.

The "first" base load Central Station Piping System operating at 1350 lbs. and 900° (back in '30)—the "first" carbon moly to be used in a complete Steam System of Central Station Piping—one of the "first" field x-rayed systems of Steam Piping and one of the "first" Piping jobs to serve a 1,000,000 lb. per hour boiler are among some of the many Navco installations.

Consult Navco for your next Piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

For Removing Water from Boiler Room Pits...

Goulds

Vertical Centrifugal Pumps

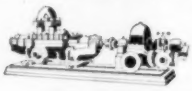
This Goulds sump pump (Fig. 3047) is widely used for removing water from pits in boiler rooms and powerhouses. Pump itself is submerged in pit and connected to motor by vertical shaft. There is no suction pipe.

Pump is built in four sizes for pit depths from 3 to 20 ft. Capacities 10 to 650 G.P.M. Heads to 65 ft.

1. Unit complete with float and automatic switch which starts and stops pump according to levels in the pit.
2. Permanent alignment of upper and lower bearings is assured by welding together the cover plate, supporting column and discharge pipe.
3. By-passing water through casing ports equalizes pressure on both ends of bearing bushing, prevents flow of liquid through bearing and assures retention of lubricant over long periods of time.
4. Shaft and impeller can be adjusted axially *without dismantling any part of the pump.* Upper bearing and bearing housing are assembled as a unit with shaft and impeller.

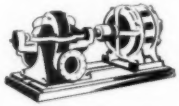
For complete information contact your nearest Goulds distributor or write for Bulletin 726.1.

Other GOULDS PUMPS for power applications



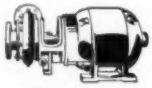
GOULDS Fig. 3360

High pressure multistage centrifugal. Capacities to 2250 G.P.M. Heads to 3050 ft. Bulletin 722.5.



GOULDS Fig. 3450

These double-suction, single-stage Goulds centrifugals will handle up to 15,000 G.P.M. Heads up to 500 ft. Send for Bulletin 721.2.



GOULDS Fig. 3650

"Close-coupled" single-stage centrifugal for general industrial use. Capacities to 2000 G.P.M. Heads to 400 ft. Bulletin 710.1.

MEMBER

Goulds PUMPS INC.

Seneca Falls New York

More APPOINTMENTS

Begins on page 224

Arnold takes over as assistant to the manager of aviation gas turbine div; James R Weaver is assistant to the vice-president in charge of manufacturing at Pittsburgh; Frank P Taugher is assistant to the vice-president and D L Pierce is manager of the industrial control engineering dept at the Buffalo plant. James M Wallace takes over managership of the meter division, succeeding G H Grossnickle, who is appointed manager of manufacturing. Edward C Edney is manager of order service for the steam division, succeeding Wm J Kastor, who has retired.

Harry C Brainard is new chief metallurgist for the **Cleveland Chain & Mfg Co.** Walter Brenton is general superintendent of **Portland General Electric Co,** succeeding J C Henkle, who retired.

Utah Power & Light Co names Paul A Blanchard steam production engineer, and John S Anderson mechanical engineer; J H Hutchinson is new assistant superintendent at the Hale plant.

A O Williamson is appointed manager of the road machinery div of **Wm Bros Boi'er and Mfg Co.** New manager of sales promotion and advertising at **Edward Valves, Inc,** is Joseph E Foley Jr. F P Diener becomes director of tests and research at **Universal Atlas Cement Co,** succeeding George L Lindsay, who has died.

Engineering Appointments

H M Rivers is promoted to director of engineering service at **Hall Laboratories, Inc.** In the dust and fume control division of **American Wheelabrator & Equipment Corp,** W S Schamel is advanced to assistant technical director. G W Roper, J K Davidson, F A Lindahl, W G Carrie, W H Williamson, and F R Culhane are new project engineers.

Robert O Bradley becomes industrial engineer for the fiber glass division of **Libbey-Owens-Ford Glass Co.**

Sales Appointments

Ransom Cooper Jr becomes manager of the nickel sales dept, and H D Tietz manager of the Inco nickel alloys dept of **International Nickel Co, Inc.** Wm L Hartley transfers to executive sales headquarters at Chicago, specializing in long-haul belt conveyors for **Link-Belt Co.**

Worthington Corp appoints J P McArthur manager of the Philadelphia district sales office; H W King is new regional manager of West Coast sales; P L McManus manager of the San Francisco district office. John S Bachman manager of paver and portable mixer sales at Plainfield, N. J.; Walter D Johnson western regional supervisor for welding positioners and industrial mixers.

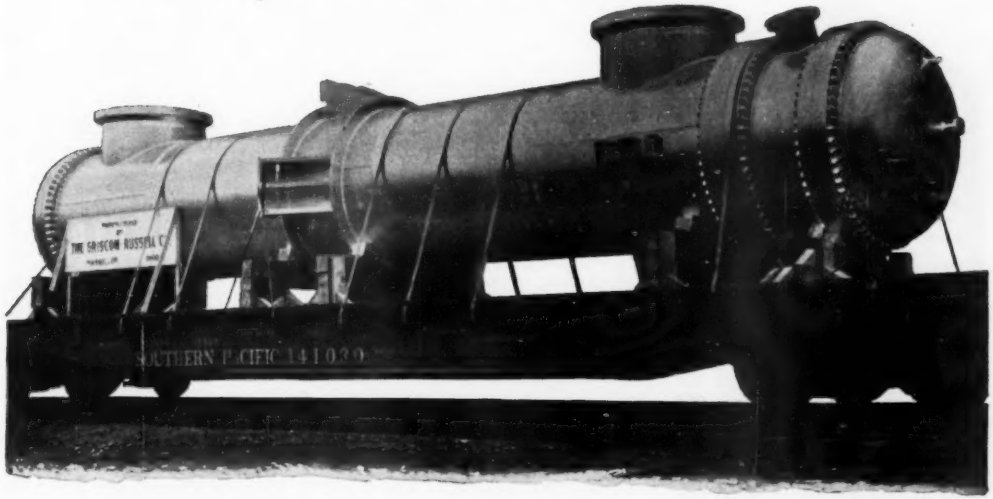
New eastern regional sales manager for **Westinghouse Electric Corp's** electronic tube division is Wm A Hayes. At **Independent Pneumatic Tool Co,** J A Hill is manager of industrial sales, J F Corkery manager of electric tool sales, and G A Thoma sales promotion manager.

John A Robinson is named sales manager

No Limit!

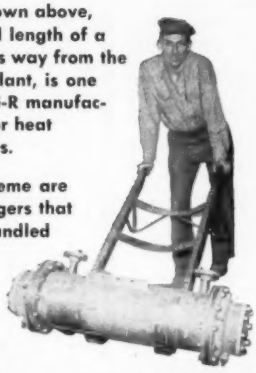
to type of

G-R Tubular Heat Exchangers



The huge unit shown above, occupying the full length of a 53-ft flat car on its way from the Griscom-Russell plant, is one example of the G-R manufacturing facilities for heat transfer apparatus.

At the other extreme are G-R Heat Exchangers that can be readily handled by one man.



Between the two extremes of the illustrated G-R Tubular Exchangers are the many types of G-R Heaters, Coolers, Condensers, Evaporators and Heat Exchangers, of which Griscom-Russell has built almost 200,000 to handle all types of liquids, gases and vapors for all industries.

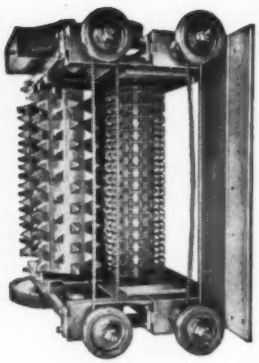
Each G-R design is based on the 85-year specialized experience of the oldest and largest exclusive manufacturer of heat transfer apparatus. Each type has many distinctive features that assure superior effectiveness, economy and durability.

Write for 32-page bulletin describing G-R Tubular Heat Exchangers in detail.

THE GRISCOM-RUSSELL COMPANY
MASSILLON, OHIO

GR 276

GRISCOM-RUSSELL
PIONEERS IN HEAT TRANSFER APPARATUS



TWO STAGE — DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates Two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports, and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578340)

T. J. GUNDLACH Machine Co., Belleville, Ill.

More APPOINTMENTS

Begins on page 224

of eastern and mid-Atlantic regions for the industrial division, **Minneapolis-Honeywell Regulator Co.** Joseph J Matulis is promoted to industrial manager for the midwest region, and C G Behnke to industrial manager of the Chicago branch office. At **Dodge Mfg Corp,** Fred J Ebeling is new general sales manager.

General Electric Co appoints Robert M Bonk southeastern district representative for construction materials. **Nordberg Mfg Co** transfers Ted J Angel to the St Louis office as district manager of the central territory. Wm L Wearly is elected general sales vice-president of **Joy Mfg Co.**

A E Dorn takes over as industrial sales manager, tractor division, at **Allis-Chalmers Mfg Co;** L W Davis becomes Pacific Coast territory manager. **Airetool Mfg Co** appoints Paul B Soderberg manager of the New Jersey office; James W Kucker succeeds him in the Chicago office.

Portland General Electric Co appoints C W Brissenden sales manager, succeeding A C McMicken, who has retired. J F McDonough becomes manager of the Marine division at **Dunham Mfg Co.** John Besemer and Claude Batuk are sales engineers for the stud welding division of **KSM Products, Inc.**

Howe Scale Co appoints these new branch managers: Fremont Fisher, Chicago; Manuel J Kauffman, Philadelphia; John R Berry, Denver; Charles J Koch, New Orleans; O B Phillips, Seattle.

New Sales Offices

Quaker Rubber Corp, division of H K Porter Co, Inc, opens new stock-carrying branch warehouse and sales office at 260 Schuyler Ave, Kearney, N. J., under supervision of A H Smith.

Geo P Reintjes Co opens new district office at 3530 Forbes St, Pittsburgh, Pa.

New Sales Representatives

Conflow Corp appoints Instrument Sales Corp, 2137 Second Ave, Seattle, their representatives in the Pacific northwest area.

Detroit Stoker Co names the Stephan Co, 7016 Euclid Ave, Cleveland, their district representatives for the Cleveland area.

Warren Steam Pump Co. appoints Stephen C May, Atlanta sales agent. His headquarters are at 585 Sherwood Rd, N.E., Atlanta 5, Ga.

Texsteam Corp, 320 Hughes St, Houston, Tex., a division of Vapor Heating Corp, will handle sales of Texsteam safety valves, chemical injection pumps, Vapor-Clarkson steam generators, etc. Sales had been made through Bettis Corp. Frank Richards is now sales manager at Texsteam.

Royalton Co representatives for pipe line expansion joints and high pressure industrial pumps are: J L Brown, Little Rock, Ark.; L C Pensinger & Son, Kansas City, Mo.; Oliver Holmes, Memphis, Tenn.; F L Holliday, Silverton 36, Ohio.

Standard Transformer Co appoints E F Lombardi, 2809 Whiting Ave, Charlotte 5, N. C., representative in North and South Carolina; Lewis E Markle Jr. 235

LIKE AN ATOM-IC EXPLOSION

Just 1/32" (pinhole size) faucet leak

MUSHROOMS into ATOMIC WASTE

of approximately 95,000 gallons of water yearly—costing:

$24.14

@ $1.90 per M cubic feet

If a hot water faucet, then (actual) FUEL WASTED heating 95,000 gallons costs approximately:

$88.91 if coal (8819 lbs.)
$91.08 if oil (792 gals.)
$84.41 if gas (84,411 cu. ft.)

Above figures authenticated by Hackensack Water Co. and American Gas Association.

STOP this needless WASTE during today's MATERIAL and MANPOWER shortages with "SEXAUER" "Easy-Tites" that outwear ordinary faucet washers 6-to-1, thus SAVING labor on 5 REPEAT repairs, PLUS water and fuel, while prolonging the life of SCARCE fixtures.

PAT'D. "EASY-TITE" FAUCET WASHERS

...a modern laboratory triumph, are compounded from du PONT NEOPRENE (tested up to 200° F.) instead of rubber—to withstand DESTRUCTIVE HEAT common in present-day superheating water systems — that formerly broke down washer's structure.

Built like a tire with fabric re-inforcement they resist the grinding, closing squeeze that SPLITS and MUSH ordinary washers out of shape... causing LEAKS.

Through combining NEOPRENE and FABRIC RE-INFORCEMENT they OUTWEAR ordinary washers 6-to-1 on hot or cold FAUCETS—thus you slash water, fuel and labor costs.

THE NEW "SEXAUER" CATALOG

Edition G, just out, pictures over 2500 TRIPLE-WEAR plumbing REPAIR parts and Pat'd. Precision Tools. It's today's accepted buying guide for discriminating purchasing and maintenance personnel among thousands of top PLANTS, INSTITUTIONS and GOVT. AGENCIES that rely on SEXAUER repair materials. Send for your copy today!

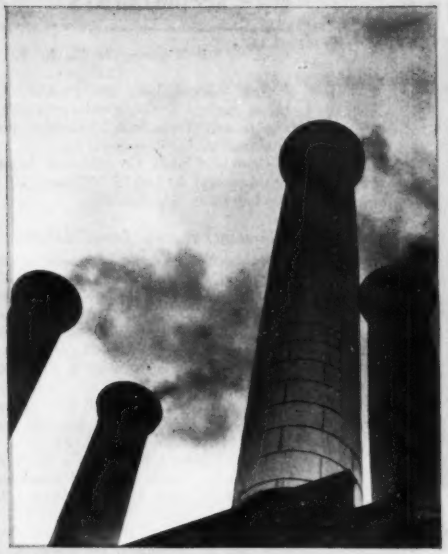
Then too, there's a SEXAUER TECHNICIAN with a quick call from coast-to-coast, who offers a special SURVEY service that sets up a schedule of the exact replacement parts required for your particular plumbing fixtures regardless of make or size and without obligation.

A postcard will bring him and your NEW Catalog promptly.

J. A. SEXAUER Mfg. Corp., Dept. AVT2
2503-05 Third Avenue, New York 51.

as advertised in the LITERARY DIGEST EVENING POST

SEXAUER
WORLD'S LEADING SPECIALISTS IN PLUMBING AND HEATING REPAIR PARTS



"Major utilities now grant complete acceptance to inhibited turbine oils"

. . . and here's why so many of them choose SHELL TURBO OIL

- ***Shell Turbo Oil exceeds every accepted specification for premium turbine lubricants. These are the notable qualities:***

1. HIGHEST ATTAINABLE RUST PROTECTION

An effective *combination* of rust inhibiting additives goes to work at the source of rust formation. Rust problems are reduced to the very lowest level.

2. COMPLETE OXIDATION STABILITY

The anti-oxidant in Shell Turbo Oil has so far defied improvement! It provides outstanding oxidation stability and thereby minimizes sludge formation.

3. ANTI-FOAMING

The anti-foam agent now used is so effective that air entrainment can be tolerated for considerable periods . . . avoiding unscheduled shutdowns.

4. EXCELLENT EMULSION CHARACTERISTICS

Shell Turbo Oil's remarkable protection against rust and oxidation is attained with the minimum tendency to formation of water emulsions in service.

5. PROTECTION AGAINST WEAR

The inhibitive agents in Shell Turbo Oil *add* to the wear-reducing qualities of the specially refined oil itself, an extra margin of safety for the bearings during critical starting period.

For additional information on Shell Turbo Oil mail coupon.

SHELL TURBO OIL

SHELL

SHELL OIL COMPANY
50 West 50th Street, New York 20, N. Y.
or 100 Bush Street, San Francisco 6, Cal.

Please send information on Shell Turbo Oil.

Name_____

Company_____

Address_____

Hendrick Open Steel Flooring . . .

gives you these outstanding advantages—

90% open area for light and ventilation . . . rectangular, square-edge steel bars that provide a safe, non-slipping, level walking surface . . . pressure-formed Mitco construction that obviates weaknesses of bolts, rivets and angle irons . . . no welds, with liability of residual stresses that lead to warping . . . ample strength to support heavy loads without any lateral deflection of flooring. Write for Hendrick Mitco Products Catalogue.

SEE OUR CATALOG IN SWEET'S

HENDRICK

Manufacturing Company

Perforated Metals
Perforated Metal Screens
Wedge-Slot Screens
Architectural Grilles
Mitco Open Steel Flooring,
Shur-Site Treads, Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

THE ANSWER TO ANY HOT WATER PROBLEM!

Pick

INSTANTANEOUS WATER HEATERS

Proved by PERFORMANCE in

STEEL MILLS
TANNERIES
LUMBER MILLS
RAILROADS
FOOD PROCESSING

CONTROLLED TEMPERATURE AT ANY VOLUME

PICK heaters provide hot water INSTANTLY by steam injection. They're entirely automatic to provide and accurately maintain pre-set temperatures. Exclusive Pressurizer Piston eliminates pipe hammering and shaking. Available in sizes and combinations to provide any volume needed. Installation is simple — requires only ordinary pipe connections.

No Storage Tanks Needed
Compact design permits installation in corners, on walls, or overhead.

Easily Cleaned
No coils. Can be cleaned in a matter of minutes — without dismantling.

Write Dept. P-10 for Engineering Details

MANUFACTURED BY
PICK MANUFACTURING CO.
WEST BEND, WISCONSIN, U.S.A.

More APPOINTMENTS

Begins on page 224

Hopkins Rd, Williamsville 21, N. Y., is representative in the Buffalo area.

New York Belting and Packing Co names Andrew G Colgin sales representative in east Texas and Mississippi, with headquarters in Shreveport, La.

Centric Clutch Co mid-west factory representative is Jack P Williams, 20 N Wacker Drive, Chicago, Ill.

Addresses, Names, Consolidations

Babcock & Wilcox Co moves its general office, and boiler and refractories district sales offices to 161 E 42nd St, New York 17, N. Y. The tubular products division district office remains at 22 E 40th St.

Chain Belt Co now occupies new adminstration building at 4701 W Greenfield Ave, Milwaukee, Wis.

H-B Instrument Co will soon occupy its newly acquired plant at American and Bristol Sts, Philadelphia 40, Pa.

Ward Leonard Electric Co moves its Los Angeles branch office and warehouse to 1605 E Olympic Blvd, Los Angeles 21, Calif.

Hydropress, Inc, its rolling mill division, and its subsidiary, the Loewy Construction Co, Inc, move to the Empire State Bldg, 350 Fifth Ave, New York 1, N. Y.

Worthington Corp redesignates as the Plainfield Works what has been known as the Dunellen, N. J. plant.

Iron Fireman Mfg Co has purchased the Petroleum Heat & Power Co oil burner business. The Petro oil burner headquarters will be moved to Cleveland, becoming the Petro division of Iron Fireman Mfg Co, with J R Crews as sales manager. Petro sales organization will remain entirely separate from that of Iron Fireman.

Olin Industries, Inc, has acquired Ramset Fasteners, Inc, of Cleveland. Ramset management will remain the same.

Obituaries

Forrest Nagler, 66, who retired March 1 as manager and chief engineer of Allis-Chalmers atomic power section, died April 1 in Lake Forest, Ill.

Wallace B Phillips, 66, president of Pyrene Mfg Co, and long recognized for his patriotic services to both the U.S. and Great Britain, died April 14 in New York.

Eric Plagwit, 76, recognized as the dean of chimney engineers, died at Pittsburgh, April 14. He had been head of the chimney division of Rust Engineering Co since 1924.

C Laurence Warwick, 62, long-time executive secretary of the American Society for Testing Materials, died suddenly on April 23.

Dr Lewis Warrington Chubb, 69, director emeritus of the Westinghouse Research Laboratories and nationally known leader in the field of science, died April 2.

C O G Miller, 86, chairman of the board and founder of the Pacific Lighting Corp, and a director of the Pacific Gas & Electric Co, died April 23.

Edward Wm Tait, 65, manager of the fabricated products dept of Combustion Engineering-Superheater, Inc, died on April 12.

engineering...

While we could not hope to duplicate this Springtime magic which Orioles take for granted, Pipe and Tubular Products is, nevertheless, a firm of engineers. Specialists in our own craft of pipe and tube fabrication, our new, larger plant at Catasauqua, Pa., enables our engineers to produce more goods in less time . . . to serve your needs with maximum speed, and at minimum cost.

Pipe and Tubular Products has a wealth of experience in producing bent tubing elements for boilers, condensers and superheaters of carbon, alloy and stainless steels as well as welded tubing and structural fabrication. Recent additions to our plant now add a complete machining department as well . . . and open up channels for increased service to our customers, both new and old.

Service has always been a specialty with us, and we are particularly adapted to supplying tubes for emergency repair work, usually shipping orders the same day on which they are received.

And, like the Orioles above, we, too, often fly our shipments direct to the site.

PIPE & TUBULAR PRODUCTS
INCORPORATED
Tubing P&TP *Specialists*

OFFICE: 8504 GERMANTOWN AVENUE, PHILADELPHIA 18, PA.
PLANT: CATASAUQUA, PENNSYLVANIA

tubing and piping • warehousing and fabricating • engineering and machining

TRAINED CREWS...

make

Kalman

"ABSORPTION PROCESS"

CONCRETE FLOORS

TOUGHER, UNIFORMLY HARDER, LONGER-LASTING

Only Kalman's crews lay Kalman heavy duty concrete floors. These are highly skilled teams, backed by 36 years' experience in laying over 250,000,000 square feet of concrete. This "know how" pays dividends in longer floor life and low maintenance!

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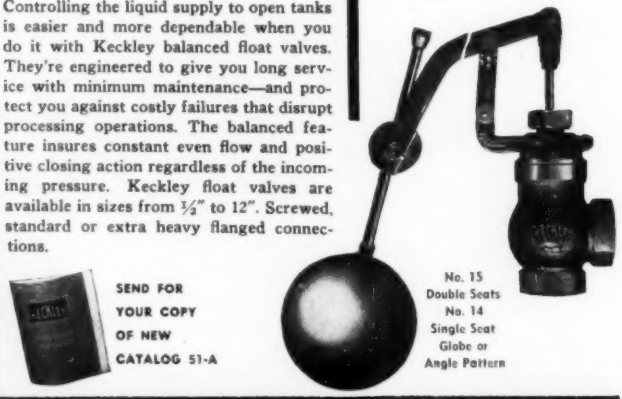
KECKLEY

FLOAT VALVES

for dependable, accurate liquid level control!

Controlling the liquid supply to open tanks is easier and more dependable when you do it with Keckley balanced float valves. They're engineered to give you long service with minimum maintenance—and protect you against costly failures that disrupt processing operations. The balanced feature insures constant even flow and positive closing action regardless of the incoming pressure. Keckley float valves are available in sizes from ¼" to 12". Screwed, standard or extra heavy flanged connections.

- No. 15 Balanced inner valve double seat. Pressures to 125 lbs.
- Specify No. 14 single seat float valve where tight closing is required.
- Bronze bodies, integral seats ½" to 1½" inclusive. Semi-Steel bodies, bronze trim, renewable seats, 2" to 12" inclusive. Globe or angle patterns.
- Seamless copper floats standard, Stainless Steel floats available.
- Closed tank controls also available.



No. 15 Double Seats
No. 14 Single Seat
Globe or Angle Pattern

SEND FOR YOUR COPY OF NEW CATALOG 51-A

O. C. KECKLEY COMPANY

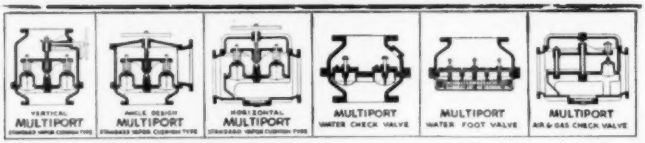
400 W. MADISON STREET CHICAGO 6, ILLINOIS

Refinite serves the World WITH WATER CONDITIONING EQUIPMENT & SERVICE

Refinite OMAHA NEB.

WATER REFINING EQUIPMENT

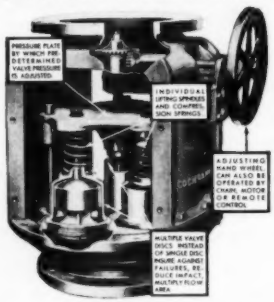
WRITE FOR FREE BULLETINS ON HOW REFINITE CAN SERVE YOU. ADDRESS: DEPARTMENT P-A



THE SAFE, TIGHT, QUIET MULTIPORT RELIEF VALVE

What Owners say about Cochrane MULTIPORT VALVES

"Twenty-five years of service. No other comment."
"Opened for inspection only once in 17 years."
"Opening and closing every 30 seconds with but little interruption for more than 12 years."
"This valve in service about 20 years with no maintenance."
"Savings cannot be computed. Absence of trouble is worth the price."
"No maintenance except change of springs for different pressure range after almost 15 years."
"No breakdown, no trouble, no expense."


PRESSURE PLATE BY WHICH PRE-DETERMINED VALVE PRESSURE IS ADJUSTED
INDIVIDUAL SPRING SPINDLES AND COMPRESSION SPRINGS
ADJUSTING HAND WHEEL CAM ALSO BE OPERATED BY CHAIN, MOTOR OR REMOTE CONTROL
MULTIPLE VALVE DISCS INSTEAD OF SINGLE DISC INSURE AGAINST FAILURES, REDUCE IMPACT, MULTIPLY FLOW AREA

Over 15,000 Cochrane Multiport Valves in Service NOT ONE KNOWN FAILURE

Cochrane Corporation
3106 N. 17th Street, Philadelphia 32, Pa.

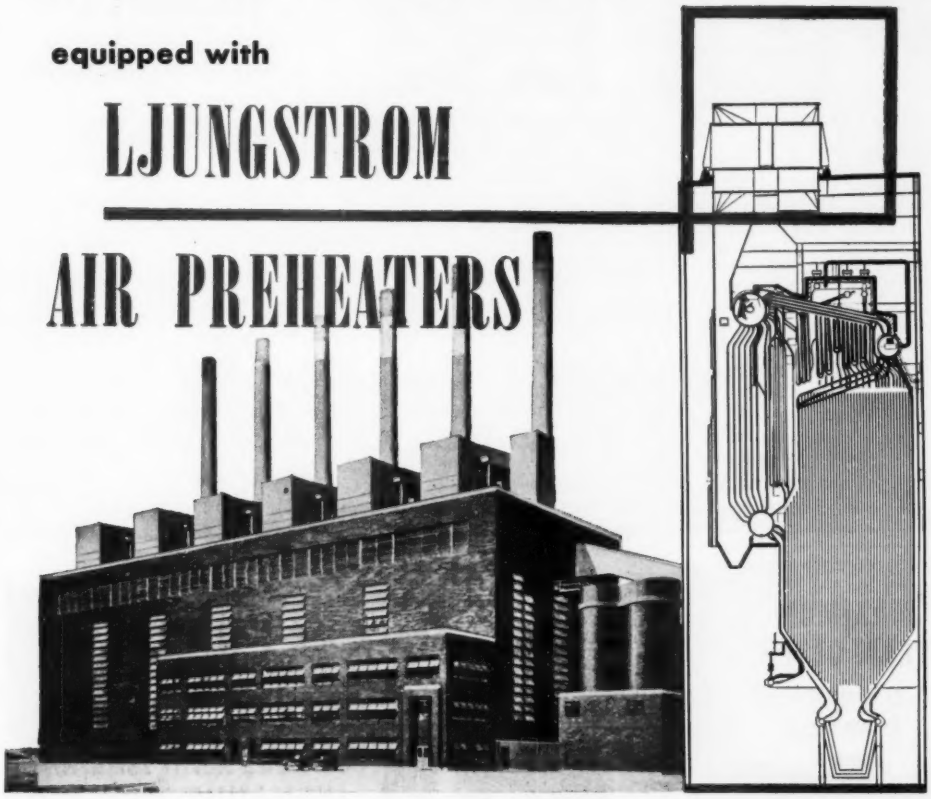
Please send me a copy of Cochrane Publication 4150 on Cochrane Multiport Valve.

Name.....
Firm.....
Address.....
City.....Zone.....State.....

Three Boilers at Noblesville Station of the Public Service Company of Indiana

equipped with

LJUNGSTROM AIR PREHEATERS



Public Service Company of Indiana, in its post-war expansion program, has added hundreds of thousands of kilowatts for the increasing needs of rural and industrial midwest.

The latest new station to go on the line is Noblesville Station, designed by Sargent & Lundy, Chicago, to add 90,000 KW to this utility's power output. Noblesville utilizes three Riley Steam Generating Units. Each unit is pulverized coal fired, with a capacity of 300,000 lb of steam per hr at 1025 psi and 950 F.

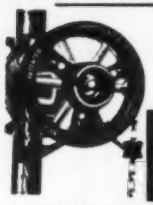
Each Riley unit is supplied with a Ljungstrom Air Preheater, which preheats combustion air to 650 F, cools exit gas to 288 F before it enters the stack.

The unanimity with which Ljungstrom Air Preheaters are chosen for high efficiency steam generating units like these is the best evidence of their high thermal efficiency and dependability. Every boiler manufacturer has included Ljungstrom Air Preheaters in outstanding installations made during the past few years.

THE Air Preheater Corporation

60 E. 42nd St., New York 17, N. Y.

NOW! All Overhead Valves are Instantly Accessible



with the LOW-COST

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 38 inches.

• Overhead valves — no matter how high up, or in whatever hard-to-get-at location — are instantly accessible from the floor! Operation of valves is quick, easy, positive and safe with the BABBITT Adjustable Sprocket Rim with Chain Guide. No more climbing on bench, machine, boiler or treacherous stepladder; no time-wasting.

• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

MARTINDALE PROTECTIVE MASKS

PLACE HEADBAND WELL UP AROUND HEAD TO KEEP FROM SLIPPING DOWN
PRESS NOSE TABS IN CLOSE AGAINST FACE TO HOLD PAD AGAINST THE NOSTRILS
PRESS EDGES OF FACE PLATE DOWN TO FIT FACE SNUGLY

Weigh Less than ½ ounce.

Clean, cool, comfortable. Furnish excellent protection against non-toxic dusts except free silica. Replaceable cotton pads are inexpensive and sanitary.

Martindale Protective Masks	$.30	ea.
No. 1 Refills (Standard weight)	.02	ea.
No. 2 Refills (heavyweight)	.02½	ea.

Masks packed in individual envelopes. Refills packed in envelopes containing 25. No. 2 (heavyweight) Refills contain twice as much filtering cotton as No. 1.

DISCOUNTS

Less than $10.00 list	Net
$10.00 to $24.99 list	10%
$25.00 to $99.99 list	15%
$100.00 and over	20%
Minimum, charge account or C.O.D.	$2.00
Minimum, cash with order	$1.00

If payment accompanies order we will pay parcel post or express charges.

MARTINDALE ELECTRIC CO.
1367 Hird Ave. Cleveland 7, Ohio

Power's HANDBOOK on Transformers

Modern transformation often means better plant flexibility and efficiency. Power's 82nd handbook boils down the practical essentials of putting today's transformers to work in your plant. Single copies: 30¢. 100 or more, 25¢. Address: Power, 330 West 42nd St., New York 36, N. Y.

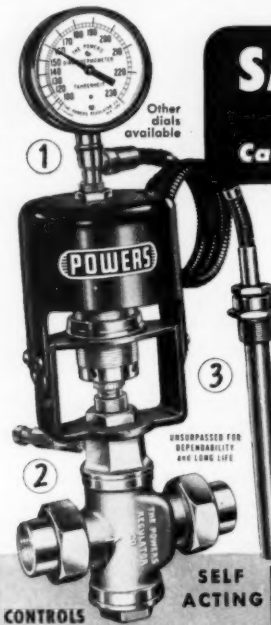
MAXIMUM STEAM OUTPUT

...at lowest cost, in smallest space!

Write for the TITUSVILLE **TICOTHERM** *bulletin ...informative, complete!*

ASK FOR **BULLETIN B-3250A**

THE TITUSVILLE IRON WORKS CO.
TITUSVILLE, PA. division of
STRUTHERS WELLS CORPORATION



SAVES LABOR

Stops Losses Caused by OVER-heating

POWERS No. 11 Temperature INDICATING REGULATORS

—need no compressed air or electricity for their operation

SIMPLIFY your temperature control problems with Powers No. 11 Regulators. They're easy to install. Use them wherever you want a rugged, self-operating control to maintain a constant temperature.

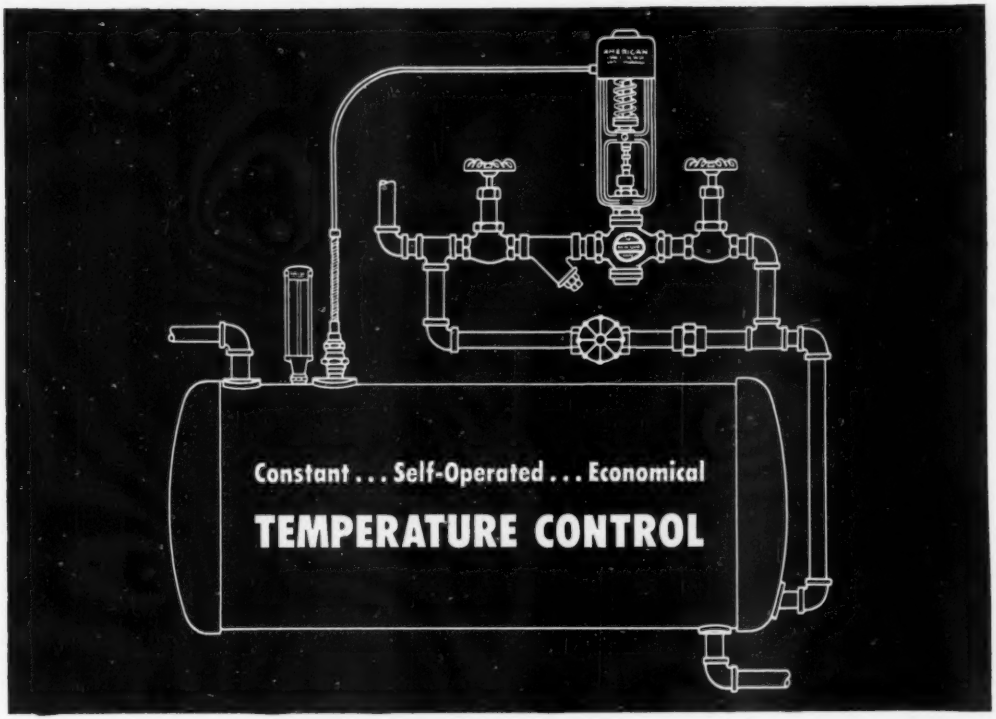
Better Temperature Control—and extra years of dependable service are assured by: 1) Easy to read 4" dial thermometer shows temperature of liquid or air being controlled, makes it easy to adjust regulator for proper temperature. 2) Has valve stem lubricator. 3) OVER-heat protection. 4) Temperature adjustment has OILITE thrust bearing.

Available also without dial thermometer in a variety of 60° F. ranges and valve bodies ¾" thru 8".

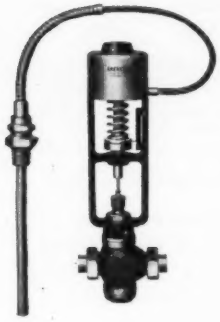
▶***WRITE FOR BULLETIN 329*** • **THE POWERS REGULATOR CO.** • 2750 Greenview Ave. Chicago 14, Ill. • Offices in over 50 Cities (11P)

SELF ACTING CONTROLS TEMPERATURE of LIQUIDS or AIR
Simple • Economical • Dependable

POWERS



WITH AMERICAN TEMPERATURE REGULATORS



Positive temperature control of water, steam, oil and other media helps product quality, reduces costs.

American self-operated, precision temperature regulators *constantly* maintain prescribed temperature limits. They are made in sizes from ¼" through 4" with two types of valve action. The *reverse-acting* is for use in *cooling* processes; *direct acting* for application in *heating* processes.

Temperature is quickly set by turning a conveniently located adjusting nut. A scale, mounted on the frame, makes it easy to duplicate any established setting. To protect the regulator if the bulb is accidentally subjected to excessive temperature, a safety spring is provided between bellows and adjusting spring. Heavy armor safeguards the capillary tubing and seamless bellows – prevents damage and disturbance of the set temperature.

American Temperature Regulators are highly efficient, dependable, durable. They can effect important economies in your processing. Full details, including selection tables, contained in Bulletin 112.

Stocked and Sold by Leading Distributors

AMERICAN INDUSTRIAL INSTRUMENTS

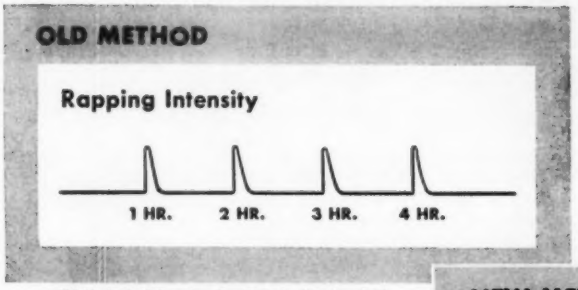
A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

New Development

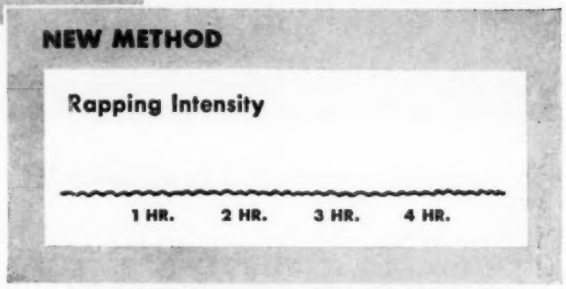
FOR ELECTRICAL PRECIPITATORS

ELIMINATES RAPPING PUFFS



Old Method of Rapping Resulting in Rapping Puff

Here are two simple diagrams that clearly demonstrate the importance of the new method of rapping developed by Research Corporation. The first shows the old way in which dust is shaken loose from electrodes at *periodic* intervals, causing intermittent puffs or clouding.



New Method of Continuous Rapping Eliminating Rapping Puffs
Rapping Intensity

This second diagram illustrates the new scientific method of cleaning electrodes. It involves continuous or sequential rapping, every minute or less, at a controlled vibrational intensity. This converts precipitation from a batch operation to a *continuous and uniform process.*

This is another major contribution by Research Corporation to the field of electrical precipitation. Constant research and development work for the past 39 years has resulted in many other improvements over the first Cottrell Precipitator. These advances plus the unequaled experience gained through over 1000 installations, listed at right, assure you of a profitable solution to your specific problem.

RESEARCH CORPORATION INSTALLATIONS

55 Carbon Black Plants
208 Metallurgical Installations
215 Acid Plants • 34 Paper Mills
293 Detarring Installations
251 Power Stations
86 Steel Plants • 114 Oil Refineries
and Miscellaneous Installations

Want to know more about the new Rapping System? Bulletin FA contains additional data. Send for your copy.

RESEARCH CORPORATION

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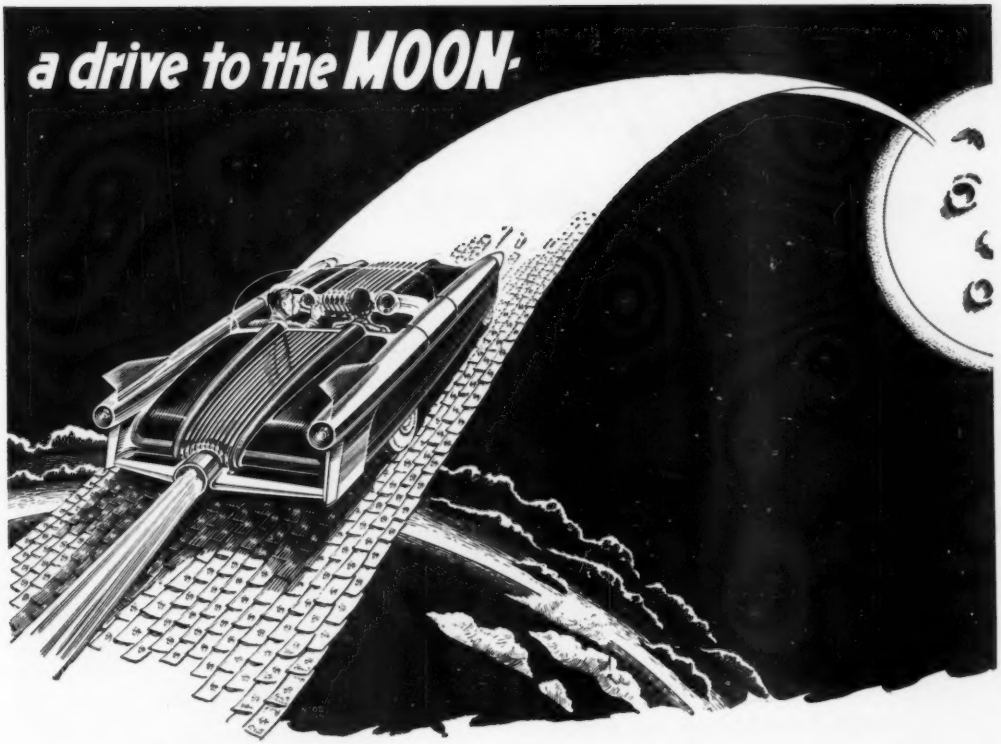
122 South Michigan Avenue, Chicago 3, Illinois
Bound Brook, New Jersey

RC-152



On a road paved with YOUR Dollars

A road twenty feet wide, carpeted with one dollar bills, extending 256,471 miles through space to the moon,--illustrates the astronomical magnitude of our Federal debt.

1932 was a bad year for most of us, whether we were in business, or looking for a job, or going to school.

1952 seems much better to the majority of our citizens, with increased business, high wages and a good education for the children.

But how much better off, really, are those of us who think "we're in clover"? Consider our National debt which has skyrocketed from 19 billion dollars to over 260 billion dollars in the past twenty years.

Such a figure is difficult to grasp. But it represents your debt, the amount that you and your family must pay. This debt is the obligation of every man, woman and child in the United States. The interest on this debt must be paid through taxes, and as the debt increases, the more our taxes will increase. If you have a wife and two children, your share of the Federal debt is now approximately $7,000.

Your debt is now 13 times what it was in 1932, and they're planning right now, down in Washington, to inflate it even more.

Do you like it? Is that what you want? If you don't like it and don't want further expansion of our Federal debt, it's up to you to let Washington know. Only when American citizens are aroused and speak up, by electing able and patriotic men to public office, will there be an end to this orgy of public extravagance.

YOUR SCRAP YOUNGSTOWN IS NEEDED

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!

. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all-metal Foxboro mercury-less *d/p Cell* offers greater speed of response, permitting closer flow *control*, than has ever been possible before. Its negligible displacement and corrosion-proof construction of Type 316 Stainless Steel eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures differential pressure by the force-balance principle and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 19 lb. Ranges: from 25" to 800" H_2O. Working pressure ratings up to 4000 psi. Steel or stainless steel construction. Inherent over-range protection. Easy in-the-field calibration and range changes. Optionally available with pre-assembled manifold piping shown in photo above.

Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. **The Foxboro Company, 687 Neponset Avenue, Foxboro, Massachusetts, U. S. A.**

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

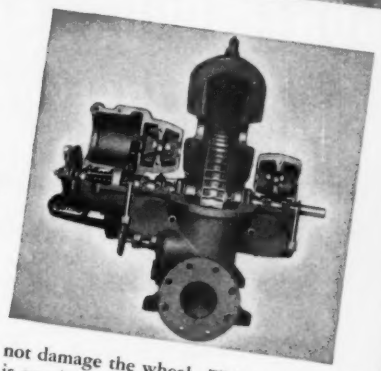
FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

FACTORIES IN THE UNITED STATES CANADA, AND ENGLAND

TERRY

LARGE CLEARANCES *take the "worry" out of* Turbine Operation

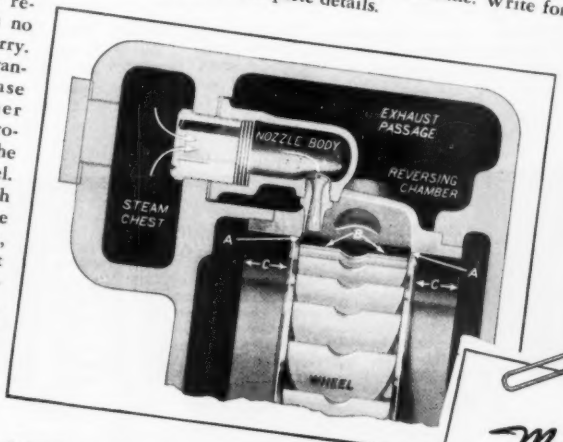


In a Terry Solid-wheel Turbine the power-producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets. This unique design permits unusually large blade clearance—see B in the diagram.

Even if this clearance becomes reduced, there is no real cause for worry. The blades still cannot foul because they are further protected by projecting rims at the sides of the wheel. These rims, which also have ample clearances (AA), will take without damage any rubbing that may occur.

Side clearance, CC, is so large that end-play from external thrust will not damage the wheel. This clearance is one inch or even greater.

Large side and blade clearances are only two of the many features of the Terry Solid-wheel Turbine. Write for complete details.



THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1191

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

IN PLANNING *Your*

CONTINUOUS PROCESSES

INCLUDE

STRAIGHT LINE FLOW Valve Advantages

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE **REDUCING VALVES**

Streamlined flow of steam, air, oil, etc., around the inner valve is an immediate solution to the important need of dependable control under varying loads.

Continuous processes can be dependably protected against slow downs, failures, and maintenance ordinarily due to valve inefficiencies. The STREAMLINED "1000" Valve with ample capacity, tight closing characteristics, close delivery pressure control, and with a wide range of adjustment makes possible speedier production, smooth operation and no spoilage.

You get straight line flow which eliminates turbulence so that at all times you are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. For the complete facts write for Bulletin "1000."

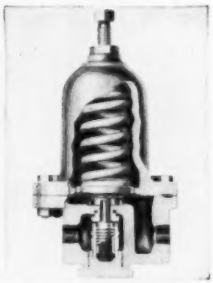
The inner valve fits right in the line as though a part of it

What might be mistaken for a pipe running through the phantom Streamlined Valve above is really the housing which contains the inner valve. Through it you have the Straightline Flow that brings such enthusiastic comments as voiced by many users.

CASH STANDARD CONTROLS.. VALVES

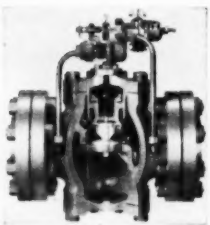
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES
Send for them



High Pressure Reducing Valve Type H-P; extra heavy for use with initial pressures up to 5000 lbs.; and for reduced pressures up to 650 lbs. Good for most fluids. Sizes: ⅜" to 2"; bronze body; nitralloy trim. Get Bulletin 931.

Type 8871 Pressure Regulator for dirty liquids (like Bunker C fuel oil). Inner valve is bolted to diaphragm for positive movement. Sizes ⅛" to 10". Bodies; iron, bronze, or steel. Seat ring and inner valve; stainless steel. Bulletin 972.



Cash Standard Type 10 Pressure Regulating Valve, pilot operated. (Pilot operating fluid discharges to outlet pipe; not wasted). Sizes: 2" to 12". Highest pressures: inlet 600 lbs.; reduced 250 lbs. Iron, bronze, or steel bodies; standard trims. For water, air, non-corrosive gases and oils. Get interesting Bulletin 966.

M. W. KELLOGG

American Gas & Electric Service Corp.
Boston Edison Co.
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Chaudronneries A. F. Smulders (Belgium)
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Sociedad De Electricidad De Rosario (Argentina)
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West Penn Power Co.
Wisconsin Public Service Corp.

M KELLOGG W

What happens to power piping here is vitally important . . . *because—*

The necessity for heat treating high-temperature, high-pressure alloy power piping, after both bending and welding, is an accepted fact. But it is the *means employed* that determine the ultimate quality of the material.

Take *this* piping scheduled for one of the larger U. S. utility plants. It has been fabricated into sub-sections by experienced Kellogg benders and welders . . . men who have produced the critical piping for power stations putting out *more than six and a quarter million KW's.*

But all this skill *can* be wasted in the furnace during heat-treating, if specific procedures are not meticulously followed. In the first such treating step, ferritic piping is *normalized* or full-annealed to homogenize the grain structure, after it has been hot bent to the desired shapes.

Normalized piping must then be *tempered*—by reheating and subsequent cooling through a carefully controlled cycle. This eliminates undesirable hardness caused by the formation of martensite during the rapid cooling while normalizing.

When normalized and tempered piping has been welded, it must again enter the furnace for *stress relieving* of the weld areas. During this operation, any substantial variation from specified temperatures may produce differences in hardness between the weld areas and surrounding metal—greatly increasing the possibility of operating failures.

To assure that utility piping is free of such potential problems, Kellogg's Metallurgical Lab sets heat treating procedures for each assembly . . . and to guarantee adherence to those procedures Kellogg furnaces are extensively instrumented. Laboratory supervision of shop practices such as these is one of the *means* that guarantee quality when you specify Kellogg power piping.

OTHER FABRICATED PRODUCTS Including:
Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchangers . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings . . . Radial Brick Chimneys

for 51 years an integral part of industrial progress!

The M. W. Kellogg Company (A Subsidiary of Pullman Incorporated)
New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

Check First with Dutton

FOR ONLY THE DUTTON ECONOTHERM GIVES YOU OFF-CENTER FIRING

AND ...HERE'S THE EXTRA ADVANTAGE OF OFF-CENTER FIRING

Induces positive, fast water circulation in a rotary motion, resulting in uniform water temperature in shell . . . faster steaming . . . elimination of surging and priming . . . a steady water line at all times . . . higher quality, dry steam . . . and a higher column of water above the furnace. Every point makes sense — makes performance too!

COMPACT
•
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ROTARY COMBUSTION
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UNUSUAL EFFICIENCY, SAFETY
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GAS, HEAVY OIL, LIGHT OIL FIRING

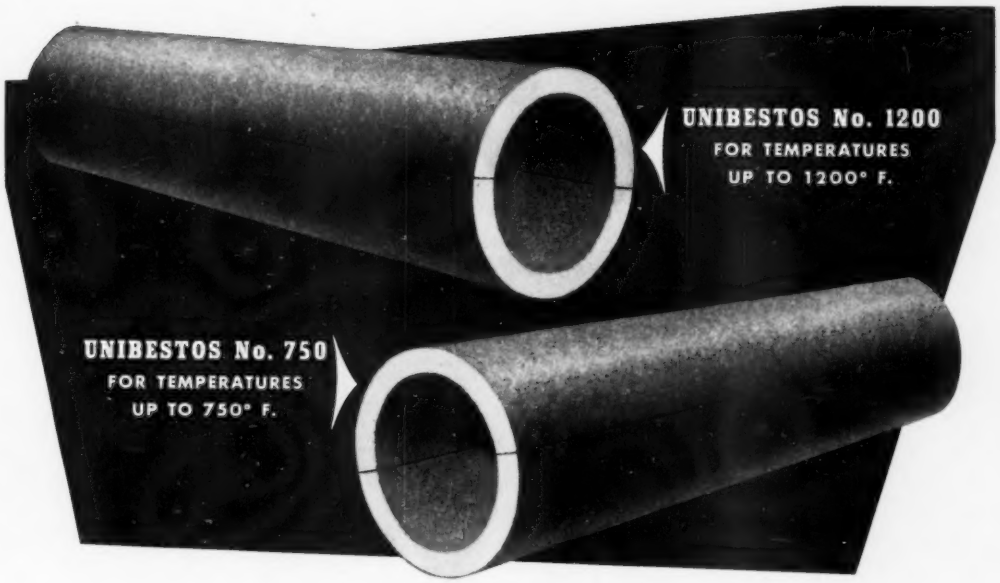
CHECK NOW with DUTTON . . . write for ECONOTHERM Bulletin EC-100C

Other types and sizes — 5 to 250 h.p. See the Yellow Pages in Phone Book for Dutton Representative.

Dutton BOILERS

DIVISION HAPMAN-DUTTON COMPANY

KALAMAZOO, MICHIGAN • BOILER BUILDERS SINCE 1880



These famous UNIBESTOS twins cut heat loss and surface temperature

HIGH EFFICIENCY IS UNIMPAIRED BY REUSE OR CONTINUOUS SERVICE

When you insulate with Unibestos you can be sure of *prolonged* effectiveness, for this durable high quality insulation resists all service hazards. It's unaffected by moisture, steam, fumes . . . withstands impact and vibration . . . won't shatter, crumble, powder, or dust to contaminate the atmosphere under normal service conditions.

Unibestos is easy to cut and fit . . . brings you the added economy of *single-layer* application . . . may be removed and reused repeatedly without damage or loss of efficiency. Adjacent sections can be stapled together to prevent separation due to expansion.

Phone your Unarco Distributor for *money-saving* Unibestos in cylinders, half-rounds, or blocks.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

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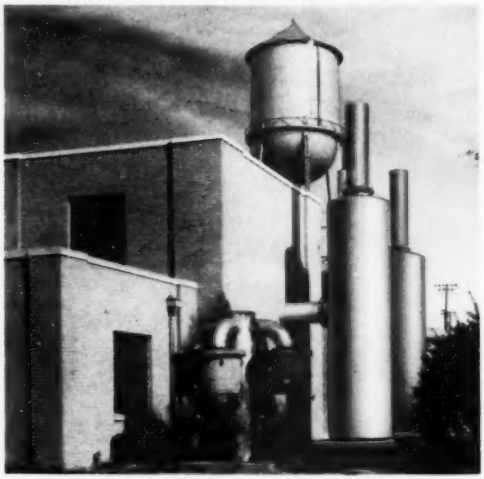
POWER-

to be acceptable in your plant or community

needs a SNUBBER



Burgess-Manning Snubbers installed on engines at power plant in Goodland, Kansas.

Equip your noisy power plant engines with

BURGESS-MANNING SNUBBERS

to quiet the disturbing roar of engine exhausts

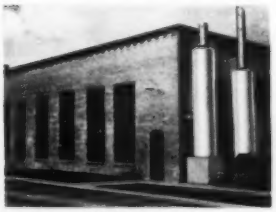
Whether engines are large or small, reliable Burgess-Manning Snubbers reduce disturbing engine exhaust noise by effectively dissipating the energy in the exhaust gas slugs. Quiet engine operation is provided without affecting performance. Burgess-Manning Snubbers are available for any degree of silencing required.

For quiet engines, install Burgess-Manning Snubbers . . . guaranteed performance backed by a reliable organization.

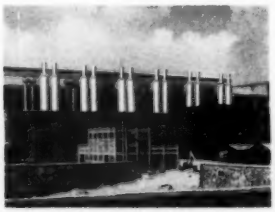
or write BURGESS-MANNING COMPANY for information on SNUBBERS that perform these functions:

- ☑ Noise Reduction plus waste heat utilization
- ☑ Noise Reduction plus spark arresting
- ☑ Noise Reduction plus surge control
- ☑ Noise Reduction plus air cleaning
- ☑ Noise Reduction plus water separating

A REPUTATION FOR OUTSTANDING SERVICE IN THESE COMMUNITIES



Sullivan, Illinois



Mexico City, Mexico

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BURGESS-MANNING COMPANY

749-J East Park Ave.

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For Silica-Free Water at Low Cost...

Deionize with AMBERLITE Resins

AMBERLITE deionization eliminates evaporators, and still gives you highest-quality boiler feed water. Silica, carbon dioxide, and hardness are reduced virtually to zero. Total ionized solids can be kept consistently below 0.1 p.p.m. In addition . . .

1. The initial cost of your water-conditioning system is reduced.
2. Operating costs go down.
3. Maintenance costs you less.
4. You are sure of an adequate supply of conditioned water—despite variations in demand and in the quality of your raw water.
5. Your AMBERLITE unit requires much less space than evaporators.
6. You have a choice of multiple-bed or Monobed (mixed bed) systems.

AMBERLITE and Monobed *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

For more information about AMBERLITE deionization, write Dept. P-2 for complete literature. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-HI-LITES.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

How these K&M insulations keep heat under power's "thumb"

THE PICTURE ABOVE, taken in a large Eastern power station, is good, but it can show only the "skin-deep" beauty of the Keasbey & Mattison Insulations on the feed water deaerator in the background and the duct in the right foreground. Under the glistening surfaces, finished tightly with K&M Insulating Cement, lies this interesting heat-keeping story.

On the feed water deaerator, the "defense in depth" against heat loss is provided by K&M Hy-Temp Blocks, 1½" thick, covered with "Featherweight" 85% Magnesia Blocks, 1½" thick... an ideal combination that makes the most of the high heat-resisting qualities of Hy-Temp and the high insulation value of "Featherweight" 85% Magnesia. Alone, "Featherweight" 85% Magnesia is good for temperatures up to 600° F. (on the duct shown it is more than sufficient); its combination with Hy-Temp provides efficient insulation from 600° to 1900° F.

These K&M Insulations are practical, economical, and durable. The insulating properties of "Featherweight" 85% Magnesia are not affected by alternate heating and cooling . . . by wetting and drying . . . and, being mineral in nature, will not burn. Both insulations are supplied in appropriate forms and thicknesses for all equipment surfaces and piping.

Your K&M distributor, who is an experienced applicator, will give you full information. Or write us direct.

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON

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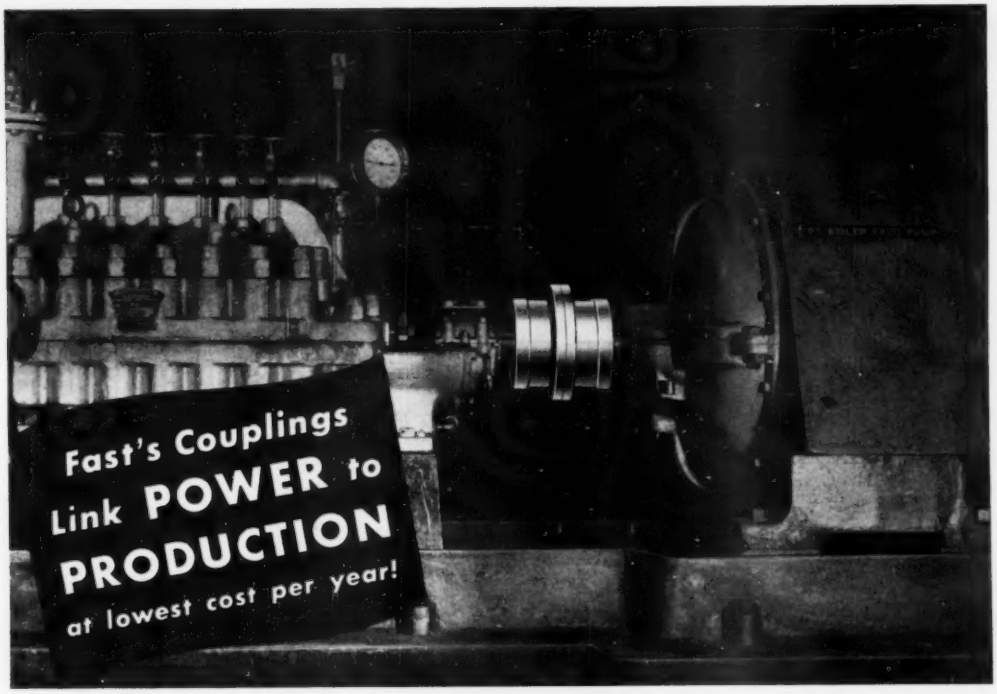
In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, and Vancouver



Over half a million FAST'S Couplings now in use!

THROUGHOUT industry, Fast's are rated the most dependable couplings on the market . . . to the tune of over half a million now in service! Year in, year out, they continue to *outlast the equipment they connect* . . . save time, maintenance and money by eliminating costly coupling failures.

Actual cases on record show many Fast's Couplings have been in operation for 25 and 30 years without trouble. And every major producer of high-speed equipment now uses Fast's!

Solve your coupling worries! Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 227 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS

FAST'S®
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

KOPPERS COMPANY, INC., ***Fast's Coupling Dept.***
227 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name _____

Company _____

Address _____

City _____ *Zone* _____ *State* _____

Minimum Span, Oversize Casing Studs
Proof against cutting between stages On Warren TH Pumps, extra heavy bolting depends on uniform pressure on gasket. is especially close to channel rings and bolts are spaced and oversized to provide uniform pressure and lock flanges together for maximum strength. (Inner bolts 1¾", outer bolts 1½")

Locked Channel and Case Rings . . .
Inter-stage seals or channel rings are not only wide to reduce by-passing between stages to minimum, but to make it possible to place casing bolts close to rings for maximum and uniform pressure on gasket. Double flange in lower half and single flange in upper half assures secure locking of channel and casing rings.

Genuine Kingsbury Thrust Bearing
Made by Kingsbury Machine Works, not modified type of other make. Oil cooled, heavy duty, duplex ball thrust bearing available and practical for discharge pressures 800 p. s. i. and lower.

Trouble-Free Solid Discharge Nozzle
Discharge nozzle is flared and extra heavy, with studs, instead of the conventional flanged type nozzle, thus eliminating danger of breakage.

Extra Heavy Casing Flanges . . . .
To provide freedom from warping, casing flanges are not only extra heavy but each bolting point is backed up with heavy boss, providing highest possible strength.

"Undercover" Facts—

why WARREN six stage, type TH high pressure boiler feed pumps are a most dependable investment.....

There are many other important factors designed to provide a sound investment over the years. Evaluate the benefits and contact Warren on your next high pressure boiler feed job. Write for Bulletin 244 giving further details.

P-25

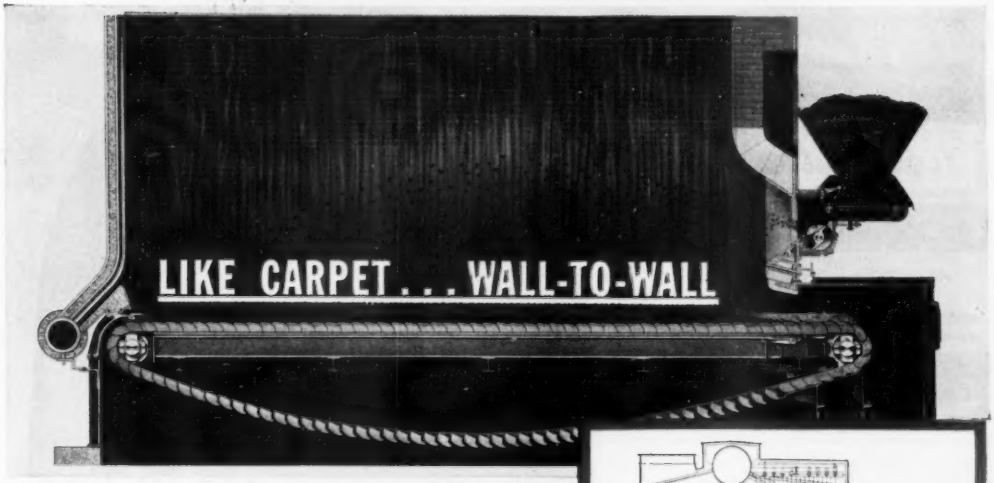
WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN MASSACHUSETTS

CUTTING A BOILER IN TWO

to show why we dare call this stoker the

PERFECT SPREAD

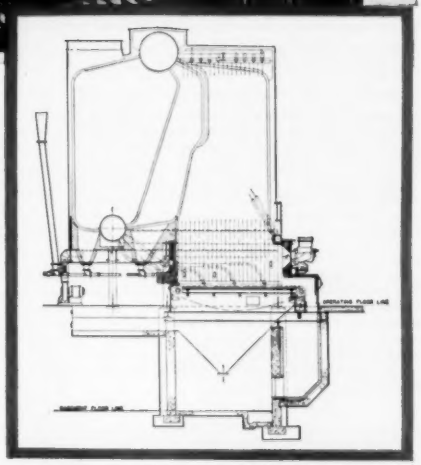


It's simple . . . it's economical and it
WON'T CLOG ON WET COAL

WHETHER THE COAL is bone dry or sopping wet, every AE conveyor feeder can deliver from 50 to 7,500 lbs. of coal per hour. The high traction principle employed—and its exclusive spiral overthrow rotor—deliver absolute uniformity of spread over the whole grate area, dependably, continually and without troublesome coal agitators.

Perfect Spread Stokers are built in a wide range of sizes, capacities and grate types . . . but *all* of them are equipped with American Engineering's exclusive conveyor feeder and rotor. This is one feeder that *won't clog on wet coal* . . . one whose true, continuous feeding is universally acknowledged as unexcelled.

If you need extra steam capacity, wish to replace obsolete equipment or abandon hand firing, mail coupon for full facts about Perfect Spread Stokers.



The above installation, designed to burn Ohio coal 11,600 B.T.U.s "as fired", 12.7% ash, 4.4% sul., with 2,000° F.—A.S.T.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2400 Aramingo Ave., Philadelphia, Penna.

Gentlemen:- We are interested in getting top efficiency from both low and high ash coals. Please send us full information about Perfect Spread Stokers.

Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____

remove the cause

...end the trouble

Take the oxygen from your boiler feed water and you put an end to costly oxygen corrosion. You spend less for repairs . . . get more hours of service from your steam power plant.

Monsanto Santosite (sodium sulfite anhydrous, technical) takes *all* oxygen from boiler water. It is safe . . . easy to use . . . economical. Santosite removes oxygen by combining with it to form harmless sodium sulfate. Neither Santosite nor sodium sulfate forms sludge or otherwise damages boilers or pipes.

Santosite is available in small or large quantities from jobbers throughout the country. For information on the use of Santosite in boiler feed water, write for Monsanto Technical Bulletin No. O-26, "Santosite for Removing Oxygen from Boiler Feed Water." MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 S. Second Street, St. Louis 4, Missouri.

Santosite: Reg. U. S. Pat. Off.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto Canada Limited, Montreal.

SANTOSITE

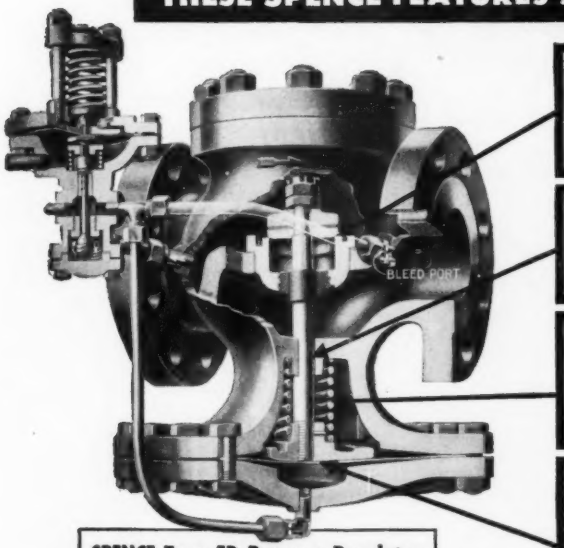
MONSANTO
CHEMICALS – PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

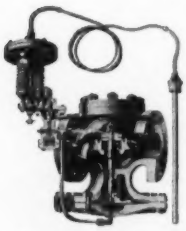
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

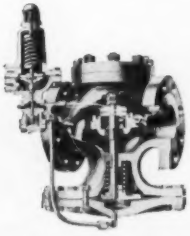
LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

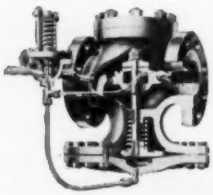
Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.



Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

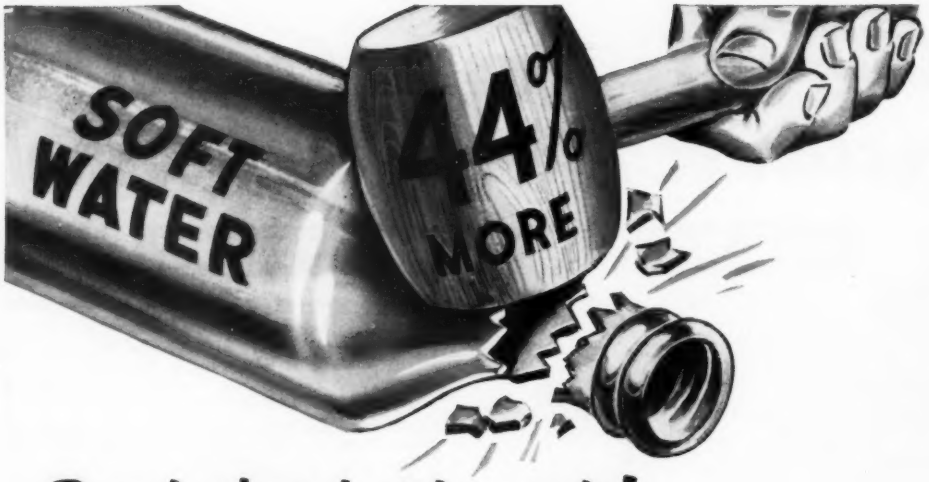
These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence



Break that bottle neck!

Get up to 44% more soft water
— from your present water softener
— or with a new Elgin Softener

It's an easy matter to break the bottle neck caused by lack of soft water. You can quickly end those hard water and scale forming troubles which interfere with boiler, process and plant service. Here's how:

If your present water softener is not giving you the soft water you need, you can increase its zeolite softening capacity as much as 44% as diagrammed, by means of the ingenious Elgin manifold arrangement. And by refilling it with new Elgin high capacity Zeolite we can further increase its soft water output *3 to 10 times.*

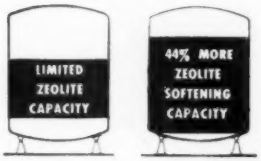
If your present water softener has served its time, or if you are now putting up with hard water, get an Elgin Water Softener of "Double-Check" design. It will deliver up to 44% more soft water than conventional water softeners of equal size utilizing the same type zeolite.

Whichever of these steps you take, the cost will be repaid quickly by the benefits and savings of soft water.

Our nearest representative will be glad to give you complete details. Or write for Bulletin 611 which gives all the facts.

Here's how it's done

By preventing zeolite loss, the Elgin "Double-Check" water softener manifold arrangement permits the use of a deeper zeolite bed and utilizes the zeolite more efficiently. Net result is up to 44% more soft water per regeneration.



ORDINARY DESIGN **ELGIN DESIGN**

Same size units; same type zeolite

ELGIN SOFTENER CORPORATION

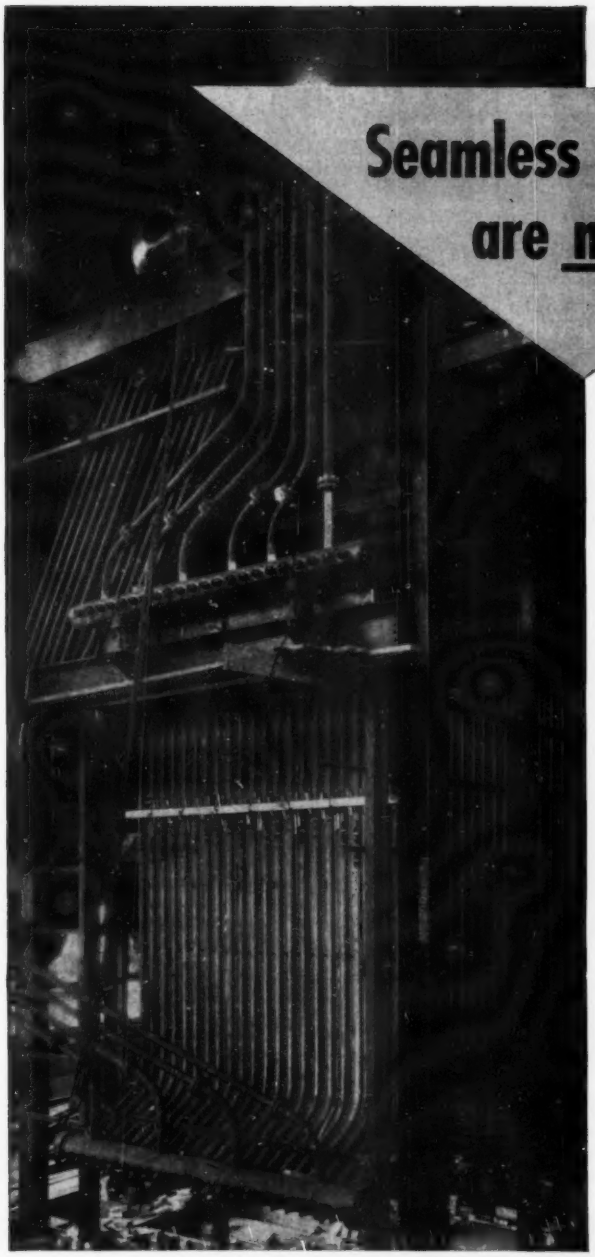
130 N. GROVE AVENUE, ELGIN, ILLINOIS

Representatives in Principal Cities

GET THE FACTS
WRITE FOR
BULLETIN 611

The "Double-Check" design of this Elgin softener gives you the basic advantages diagrammed opposite.

ELGIN
SINCE 1908
WATER CONDITIONING
FOR EVERY NEED



Seamless Tubes are mandatory

for severe boiler service

For proof, look to the power plant. Absolute safety is a must, therefore designers have invariably standardized on seamless boiler tubes.

National Seamless Boiler Tubes usually get first call because they have been thoroughly proved in so many thousands of actual installations. Every tube is as sound as a solid forging because it is actually pierced from a solid billet of steel, the *one* manufacturing method that removes all doubt concerning uniform wall strength.

Next to the consideration of safety, the most important factor about a boiler tube is its lasting quality. The long years of experience and up-to-date plant equipment of National Tube have "built in" the finest qualities for long service into every National Seamless Tube.

These National Seamless Boiler Tubes are easy to install, too. Precise annealing cycles give the right balance between strength and ductility; therefore the tubes are easily bent, expanded, flared, beaded and tightly rolled into headers or sheets without danger of fractures or splits.

For more information about these dependable tubes, write to National Tube Division, United States Steel Company, 525 William Penn Place, Pittsburgh, Pa. Ask for bulletin No. 12.

NATIONAL TUBE DIVISION, UNITED STATES STEEL COMPANY, PITTSBURGH, PA.
(TUBING SPECIALTIES)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL *Seamless* BOILER TUBES

UNITED STATES STEEL

Get This NEW Oakite Booklet—FREE

HERE'S how to lick such tough jobs as stripping paint, enamel, lacquer, varnish, etc., from transformers, motor and controller housings, burned-out armature and motor windings. Booklet tells how Oakite stripping methods eliminate sand-blasting and scraping . . . how Oakite Compound No. 33 prepares surfaces for longer-lasting re-paint jobs.

Get your copy today. Write Oakite Products, Inc., 23 Rector St., New York 6, N. Y.

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MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

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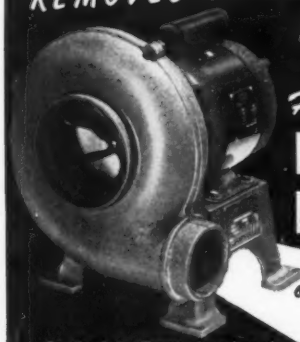
REMOVES FUMES—DUST FASTER!



High Quality

PRESSURE BLOWER

only **$49.50**

REG. PRICE $70.00

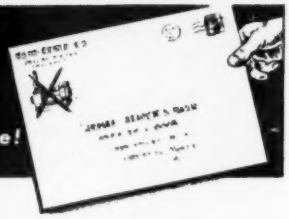
For the fast, efficient elimination of welding fumes, sawdust, or other air impurities, you can depend on this precision-made, all-aluminum high-pressure blower. Made with 5½" inlet and 3½" outlet. Enclosed ¾ H.P. Westinghouse single phase motor, 115 V., A. C., provides 3450 R.P.M. and up to 450 C.F.M. Immediate delivery! Ask for #BL50W.

STANDARD ELECTRIC

MFG. CO., INC.

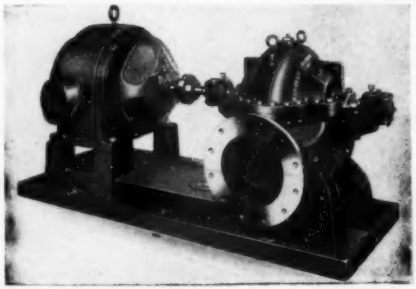
WEST BERLIN 42, N. J.

The "LOW-BID" PUMP isn't necessarily the economical one!

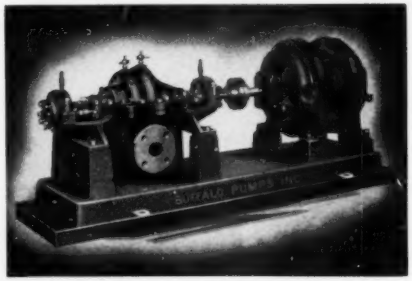


"Buffalo" PUMPS

Save Money on the Job — WHERE SAVING COUNTS!



Above, for handling clear water, 10 to 14,000 gpm, you can't beat a "Buffalo" Type "SL" Pump.



For clear water, any temperature, at pressures up to 500 pounds, specify a "Buffalo" Type "RR" Pump.

If the pump has been built down to a price rather than up to a quality standard, chances are that any savings on first cost will be nullified by continual repair and replacement costs. "Buffalo" Pumps have always been built to save your maintenance men trouble, to keep delivering for a maximum number of years and to use minimum power.

But why not get the construction and performance facts? Write today for Bulletins 955-P and 980-B, and see why "Buffalo" Pumps save money the minute they start on the job.

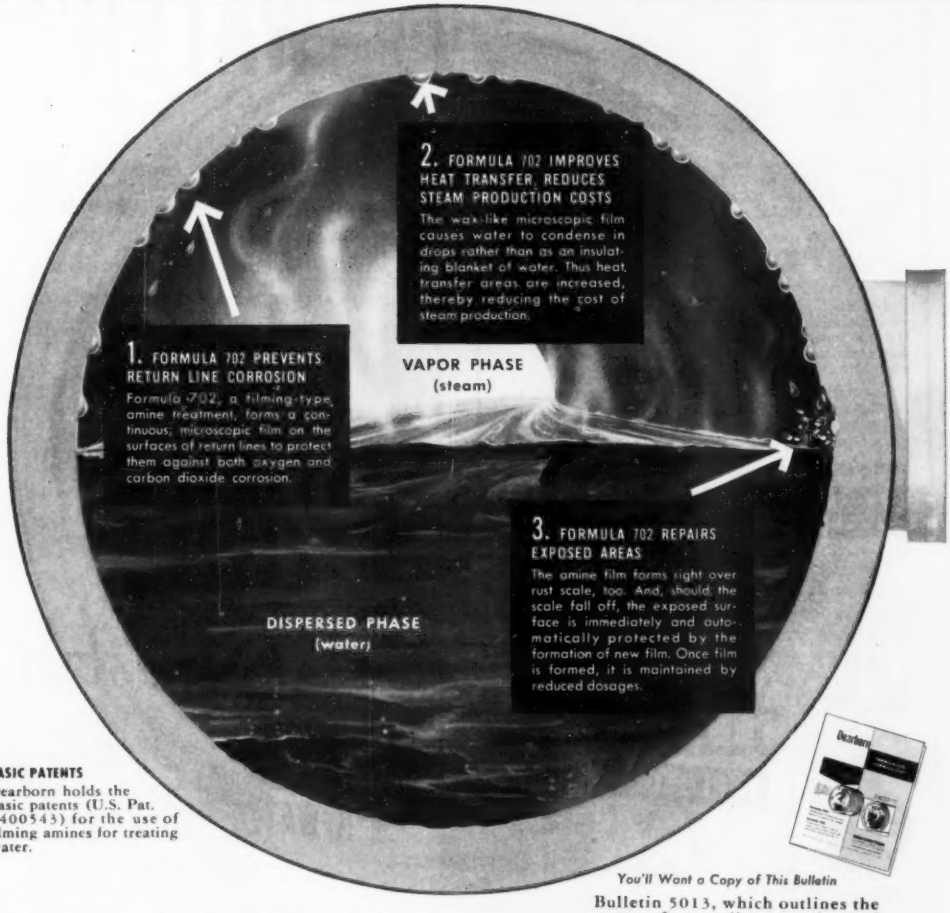
BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

3 reasons why every power engineer should know about Dearborn Formula 702


2. FORMULA 702 IMPROVES HEAT TRANSFER, REDUCES STEAM PRODUCTION COSTS
The wax-like microscopic film causes water to condense in drops rather than as an insulating blanket of water. Thus heat transfer areas are increased, thereby reducing the cost of steam production.
1. FORMULA 702 PREVENTS RETURN LINE CORROSION
Formula 702, a filming-type amine treatment, forms a continuous, microscopic film on the surfaces of return lines to protect them against both oxygen and carbon dioxide corrosion.
VAPOR PHASE (steam)
3. FORMULA 702 REPAIRS EXPOSED AREAS
The amine film forms right over rust scale, too. And, should the scale fall off, the exposed surface is immediately and automatically protected by the formation of new film. Once film is formed, it is maintained by reduced dosages.
DISPERSED PHASE (water)

BASIC PATENTS
Dearborn holds the basic patents (U.S. Pat. 2400543) for the use of filming amines for treating water.

This cross-section of a return line, showing how *Dearborn Formula 702,* which is fed directly into the boiler, works to eliminate costly corrosion, reduce maintenance, avoid shutdowns and protect valuable equipment. If the pH value of your steam condensate is excessively low, it will pay you to discuss Formula 702 with your Dearborn Engineer.

DEARBORN CHEMICAL COMPANY • Merchandise Mart Plaza • Chicago 54, Illinois

You'll Want a Copy of This Bulletin

Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.

Dearborn Chemical Company **Dept. PO**
Merchandise Mart Plaza
Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

Name.....
Position.....
Company.....
Address.....
City.....*Zone*.....*State*.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

87

varieties

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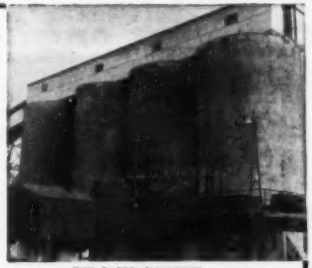
stored in N&F silos



THE PAPER INDUSTRY

The photo shows four 30 x 60 ft. Neff & Fry silos used for storing wood chip at a pulp and paper plant. Each holds 30,000 cu. ft. of chips, enough to make 80 tons of pulp, which is 16% of the daily run.

Wood chips are one of the 87 kinds of flowable bulk materials handled in Neff & Fry Storage Bins. The list includes ashes, cement, clay, coal, grain, gravel, lime, nuts, ore, rock, sand, seed.

The distinctive feature of a Neff & Fry Bin is the diagonal-ended Super-Concrete Stave . . . formed under 140 tons pressure . . . . virtually as dense, strong, and enduring as natural stone. The stave does not rot, rust, burn, or spall.

Get the whole story in our folder, "Bins With the Strength of Pillars." Ask for it now while you have the subject in mind.

Not exported except to Canada and Mexico

THE NEFF & FRY CO. • 270 Elm St., Camden, Ohio

SUPER-CONCRETE STAVE STORAGE BINS — NEFF & FRY

TYPE PLF EXHAUST FAN

TYPE PLDX DUCT BOOSTER

TYPE PLBD PRESSURE FAN

TYPE PLDU AIR BLASTER

Write for Catalog No. 400 address Dept. V-7.

FOR HAZARDOUS LOCATIONS USE-

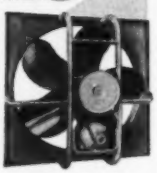
CHELSEA

EXPLOSION-PROOF FANS

THE ABC OF SAFETY—

Always Buy Chelsea

Performance - proven CHELSEA explosion-proof fans meet rigid ventilating and exhaust specifications to the letter. For hazardous locations, specify CHELSEA type fans supplied with Class I, Group D motors, and non-ferrous, non-sparking propellers. Ask CHELSEA for recommendations for your particular processing or industrial need.



CHELSEA TYPE IND INDUSTRIAL FAN for general ventilating and comfort cooling in factories, foundries, plants, mills, laboratories, etc. Flexible and efficient, it is capable of moving large volumes of air.

CHELSEA FAN & BLOWER CO., Inc.
PLAINFIELD, NEW JERSEY

"WATER"

In its September issue, Power presents the biggest editorial project assigned to it in recent history. And the subject is . . . water. It will be treated in a special 48-page section, which divides itself naturally into three important and interesting sub-topics:

- **THE WORLD OF WATER**

  A nature story of wind and weather

- **WATER SHORTAGES IN A LAND OF PLENTY**

  What we're doing about them.

- **A WATER PROGRAM FOR YOUR PLANT**

  The important facts on sources, purification and conservation.

We believe this study of water could be one of the most talked-about and longest-lived reports our field has known. Watch for it in the September Power.

Powell Performance

proved by actual service records

in leading power plants throughout the country

The preference for Powell Valves in both industrial and utility power plants throughout the country is based on records of actual performance under all kinds of service conditions.

Powell Valves for Power Plants include all types in Bronze and Iron for water, oil, gas and low pressure steam and Cast Steel for high pressure—high temperature services.

Fig. 1314-A—1500-pound Steel Integral Bonnet "Y" Valve with socket weld ends. Sizes ½" to 2", incl.

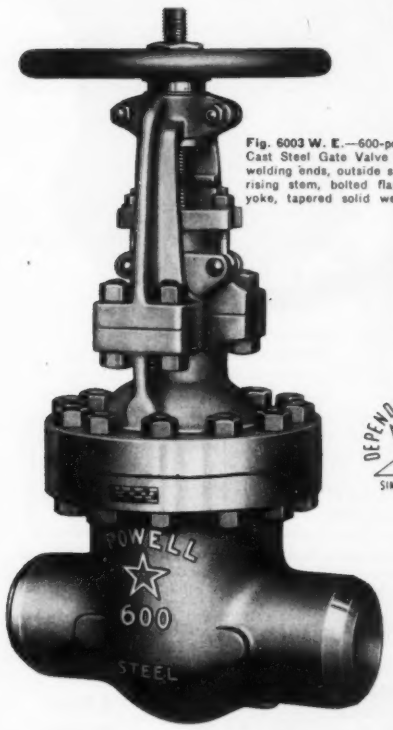


Fig. 6003 W. E.—600-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

Fig. 375—200 pound Bronze Gate Valve. Screwed ends, inside screw rising stem, union bonnet and renewable wear-resisting "Powellium" nickel-bronze disc.

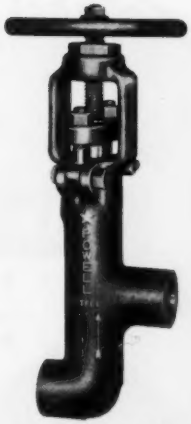


Fig. 1331-A—Steel Integral Bonnet Offset Globe Valve with socket weld ends. For 1500 pounds W.P. Sizes ¼" to 2", inclusive.

DEPENDABLE VALVES SINCE 1846

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc.

POWELL VALVES

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

HELD . . .

at pumping temperature

• Oil, wax, asphalt and similar products stored in large tanks are held accurately at pumping temperature with simple SARCO SELF-OPERATED TEMPERATURE REGULATORS applied to suction heaters or steam coils.

No compressed air required.

Sizes ½" to 8"; temperatures to 300°F.

Ask for Bulletin 603

520

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

Represented in Principal Cities

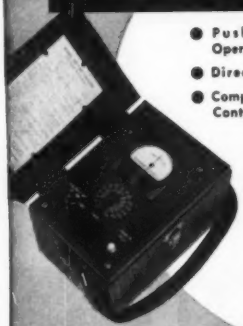
SARCO CANADA LTD., TORONTO 5, ONTARIO

Simple • Accurate

GROUND RESISTANCE TESTING

with

VIBROGROUND



- Push-Button Operation
- Direct-Reading
- Completely Self-Contained
- True readings, regardless of earth resistance and condition, stray frequencies, voltages or currents

YOU can be sure of safe, effective grounding of all types of electrical systems when you test with the light, easy-to-use Vibroground. Simple operation and built-in accuracy virtually eliminate reading errors. No leveling, cranking or outside power source is necessary; and direct readings are independent of auxiliary probe resistance.

Full data on Vibrogrounds, including testing techniques and illustrations, is yours for the asking.

Write for BULLETIN 105

ASSOCIATED RESEARCH, Incorporated

"Precision Instruments Since 1936"

3770 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

WING Type EMD BLOWER

VOLTROL VANE CONTROL MECHANISM
LEVER FOR CAPACITY REGULATION (Suitable for attachment to Combustion Controller)
VOLTROL (Volume Control) VANES giving Capacity Regulation down to 10% of Max
AIR STRAIGHTENING VANES
FULLY ENCLOSED DUST-PROOF MOTOR
WINGFOIL AXIAL FLOW FANWHEEL—Highly Efficient. Mounted directly on Motor Shaft
BLOWER ATTACHED TO WIND BOX OR AIR DUCT AT THIS FLANGE. NO OTHER SUPPORT REQUIRED. Can be arranged for Horizontal or Vertical Mounting

Wing Blowers can be furnished in Single Stage (Type EMD) as shown above, or in Two Stage (Type COM), where the second fan would be mounted on the other end of the motor.

L. J. Wing Mfg. Co. 50 Vreeland Mills Rd. Linden, New Jersey

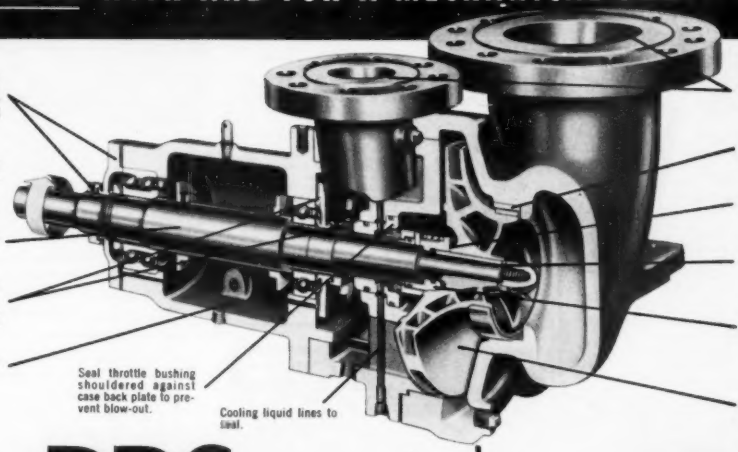
Offices in Principal Cities of U.S. & Canada

Wing

AXIAL FLOW FORCED DRAFT BLOWERS

First FROM PEERLESS

A HEAVY DUTY REFINERY & CHEMICAL PROCESS PUMP DESIGNED *WITH AND FOR* A MECHANICAL SHAFT SEAL


Slinger and special recessed bearing cap provide an effective seal without wearing parts.
Heavy duty thrust and radial bearings oil-lubricated.
Precision alloy steel, heat-treated, shaft.
Slinger and special recessed bearing cap provide an effective seal without wearing parts.
Extra large capacity oil reservoir.
Seal throttle bushing shouldered against case back plate to prevent blow-out.
Cooling liquid lines to seal.
Top suction and top discharge design. End-suction design available.
Case and impeller wearing rings are spot electric welded.
Mechanical shaft seal assembly.
Lock washer secures hex nut on shaft.
Seal sleeve keyed to shaft, gasketed at shaft shoulder to prevent leakage under sleeve.
Enclosed type impeller is keyed to shaft; repelling vanes on back shroud.

PEERLESS *type* PRS PROCESS PUMP

The Peerless Type PRS pump is designed *specifically* for mechanical shaft seal construction. All the advantages of proved mechanical seals are inherent in the Type PRS pump design.

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2. GREATER SAFETY. Throttle bushing is shouldered against case back plate from suction side; cannot blow out even under maximum operating pressure.

3. MORE ECONOMICAL. No premium is charged in first cost for the mechanical shaft seal construction of the Type PRS pump. Lower maintenance costs will be effected throughout its longer life.

4. AVAILABLE IN SEVERAL SIZES. Peerless Type PRS pumps are available for quick assembly and shipment from Peerless' Los Angeles stock in several sizes.

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PEERLESS PUMPS

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Capacities	up to 1000 gpm
Operating Heads	up to 625 feet
Case Pressures	up to 400 psig
Temperatures	up to 250° F
Drives	horizontal electric motor is standard; other types available as required.

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Use the Peerless Type PRS pump for handling all petroleum hydrocarbons, process liquids, water, hot oil, LP-gases. Liquid end can be furnished in material suitable to the intended service.

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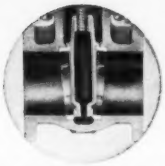

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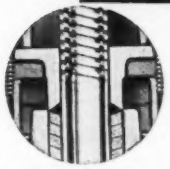

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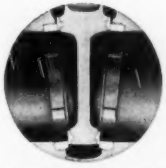

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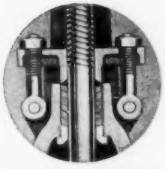

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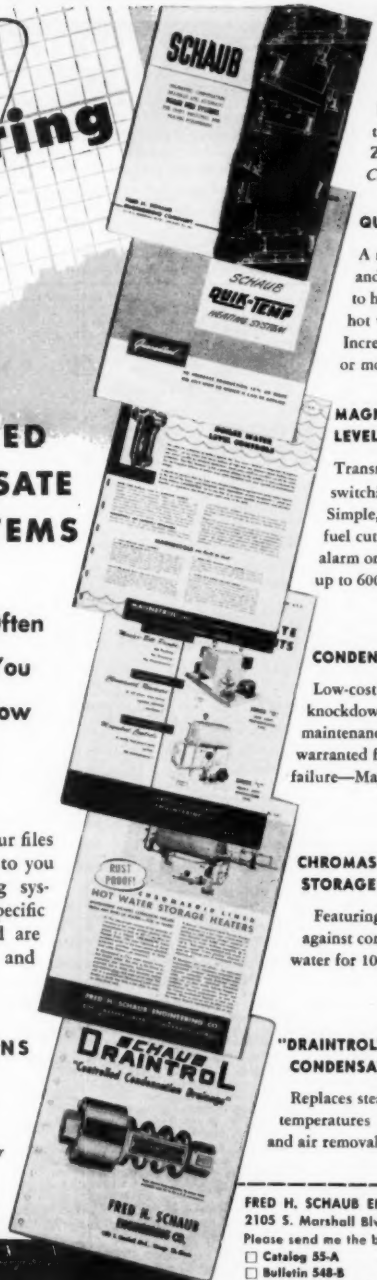

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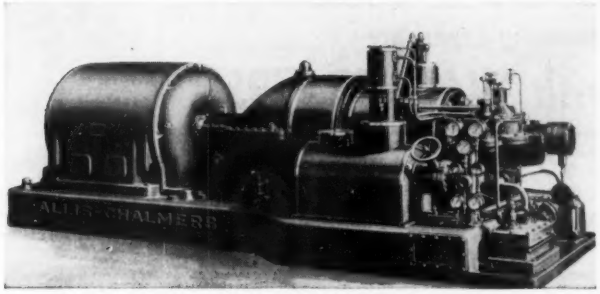

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7— 750 KW, Allis Chalmers, 150/200 psig, 3/60/480 Volt
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12— 750 KW, General Electric, 150/200 psig, 3/60/480 Volt
13—1000 KW, General Electric, 175/250 psig, 3/60/2300 Volt
14—1000 KW, Westinghouse, 220/450 psig, 750°TT, 2400/4160 V
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18—1000 KW, Allis-Chalmers, 150/200 psig, 3/60/440 Volt
19—1500 KW, Allis-Chalmers, 150/200 psig, 3/60/2300 Volt
20—2000 KW, General Electric, 175/200 psig, 3/60/2300 Volt
21—2500 KW, General Electric, 150/250 psig, 3/60/2300-4160 V
22—2500 KW, General Electric, 150/200 psig, 3/60/2300 Volt
23—3000 KW, General Electric, 150/250 psig, 3/60/480 Volt
24—5000 KW, General Electric, 150/200 psig, 3/60/2300-4160 V

NON-CONDENSING TURBINES IN OUR STOCK

25—2500 KW, General Electric, 150/175 psig, 10/15-BP., 2300 V
26—2000 KW, Westinghouse, 250/350 psig, 25/40-BP., 2300 V
27—1250 KW, General Electric, 125/150 psig, 12/15-BP., 480 V
28—1000 KW, General Electric, 150/175 psig, 15/25-BP., 2300 V
29—1000 KW, Westinghouse, 150/175 psig, 15/25-BP., 480 V
30-31—500 KW, General Electric & West. 250/450# psig, 125 B.P. 480 V
32-33—500 KW, Allis-Chalmers, 110/140 psig, 15/25-BP., 480 V
34—3000 KW, 450# psig, Extr. 150, Non-cond. 60#
35—4000 KW, 600# psig, Extr. 250, Non-Cond. 25#

ALL MACHINES ARE 3600-RPM. NEARLY ALL CAN BE RECONNECTED.

BOILERS, ETC.: Please Send Us Your Specs. CORRESPONDENCE INVITED.

TELEPHONE
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TELEGRAPH

CHARLES WEAVER
4145 Penobscot Bldg., Detroit 26, Michigan

Telephones: WO. 1-1340
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WAGNER CERTIFIED REBUILT

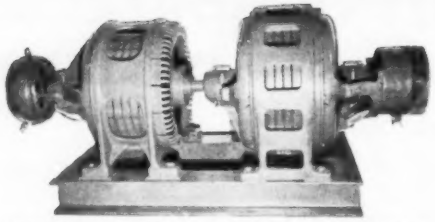

Photo of special 500 KVA AC synch. M-G set—engineered, rebuilt and assembled in our shop—shipped to Mexico for operation of electric pipewelding machine. Complete control panels included.

Get the Benefit of our 46 YEARS of Engineering Experience - -

"Check with WAGNER FIRST"

Complete shop facilities—Dynamic Balancing—Dynamometer Testing—plus a large selection of fine equipment—these are among the many advantages when you buy Wagner "Certified Rebuilt". Save Time & Money Safely!

PARTIAL LISTING OF LARGER ITEMS IN STOCK

A. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
800	G.E.	Slipring	2200/4000	600
750	Whse.	Synch.	2200,4000	900
700	G.E.	Synch.	2200	514
500	G.E.	Sq. cage	6600/4000	1800
500	G.E.	Sq. cage	440	3600
500	G.E.	Synch.	440	900
500	G.E.	Slipring	220/440	450
500	Al. Ch.	Synch.	440	400
450	Whse.	Synch.	2300	900
400	Whse.	Slipring	2300	514
350	G.E.	Slipring	440	720
300	G.E.	Sq. cage	2300	1800
300	Whse.	Synch.	2200/440	600
300	G.E.	Slipring	2300	1800
300	Al. Ch.	Slipring	440	360
250	Whse.	Sq. cage	2200/440	1200
250	G.E.	Sq. cage	440	600
250	Al. Ch.	Slipring	2300	514
250	L.A. (2)	Sq. cage	2200	1800
225	E.M.	Synch.	440	1800
225	G.E.	Synch.	2300	900
225	G.E.	Synch.	220/440	600
200	G.E.	Slipring	220/440	360
200	F.M. bb	Slipring	2300	900

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
600	Gen. Elec.	ATB	480	900
500	Gen. Elec.	ATB	480	900
485	Allis. Ch.	1 brg.	480	400
312	Gen. Elec.	ATB	240/480	600
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	2300	900
225	Gen. Elec.	ATB	240/480	600
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900

M-G SETS

KW	Mfr.	Input V	Output V
500	G.E. HCC conv.	2300 AC	275 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
200	Whse.*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.*	2300 AC	275 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	220/440 AC	70 DC
100	G.E.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
100	Allis Ch.	220/440 AC	125 DC
100	Allis Ch.*	220/440 AC	50 DC
75	Whse.*	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
50	Whse.	220/440 AC	250 DC
45	Gen. Elec.*	220/440 AC	60 DC
40	Whse.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	250 DC
35	C.W. b.b.	220/440 AC	125 DC
25	Whse.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	275	700
300	Whse.	SK	600	900
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
100	Allis Ch.	E	125	1200
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW	125/250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	230	500
200	Reliance	1400T	230	850
175	Gen. Elec.	RC	230	1650
150	Gen. Elec.	MPC	230	500/1200
150	Whse.	SK183	230	1150
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	CD123	115	1500

QUICK SHIPMENT FROM STOCK — LOW PRICES — FULL GUARANTEE

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CERTIFIED

Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7400 CHICAGO 7, ILLINOIS

TRANSFORMERS

60 Cy. Single and 3 Phase

KVA	Make	Pri. Volts	Sec. Volts
		—Voltages—	
6000(1)	Am. Br. Bov.	2400	5040/4800Y
3750(1)	Uptegraff	22000	600
3750(1)	Uptegraff	22000	440
3000(1)	Uptegraff	22000	440
3000(1)	GE	22000	480
3000(1)	Uptegraff	22000	550
2500(3)	West.	27600	2300
2000(3)		45000	2300
2000(4)		21000	6800
1500	GE	2200	600
1250(3)	GE	11000	2200
1000	West.	2200	220
833(2)	GE	13800	460
833(3)	West.	2300	575
800(3)	GE	22000	2300
750(4)	GE	2200	244/488
667(3)	GE	13200	2300/4000
667(1)	Al. Ch.	13200	480
500(2)	GE	11000	2300
500		4600	460
500(6)	GE	33000	6600/2300
500(3)	GE	11400	40/80
500(6)	GE	6640/11500Y	75/120
500(1)	GE	12100	100
450(3)	GE	2300	445
450	Uptegraff	11000	460
450(1)	Uptegraff	11000	230
400(2)		2300	3 ph. 230
400(3)	GE	2200	244/488
333(1)	GE	22000	2200
333(3)	GE	22000	2200
333(1)	GE	22000	2300
333(2)	GE	11500	115/230
333(3)	GE	11000	2200
333(3)	West.	2400	120/240
300(3)	West.	14520	550/230
300(1)	Pitts.	6600	110
300(3)	Pitts.	2300	115/230
300(2)	GE	2300	115/230/440
250(1)	GE	2400	240/480
250(3)	Mol.	34500	2300
250(3)	GE	2400	240/480
250(1)	Wag.	2200	440
250	West.	463	
200(3)	West.	26400	267
200(4)	West.	13800	278
200(3)	West.	13200	2300
200(3)	Al. Ch.	33000	220/440
200(3)	L.M.	7200	120/240
200(2)	Pitts.	12000	115/230
200(3)	Wag.	2300	230/115
200(3)	GE	2400	120/240
200	GE	495	120/240
200	GE	2200	122/244
200	West.	2300	600
200	GE	11500	460
200	West.	3984	115/230
200	GE	6900	2400
150(1)	West.	6900	120/208
150(3)	West.	14400	600
150(3)	West.	14400	575/230
150(4)	GE	12000	115/230
150(1)	West.	2400	480
150(4)	Packard	4600	230/115
150	GE	2400	240/480
150(3)	GE	2200	110/220
150(3)	Pitts.	7200	115/230
150(3)	GE	4150	120/240
125	West.	440	440
125	West.	440	440
100(4)	Penn.	600	120/240
100(3)	GE	14490	2400/4800
100(2)	Al. Ch.	4600	230/115
100(2)	West.	13200	220
100(4)	Al. Ch.	2400	480
100(2)	Pitts.	2300	230/460
100(1)	West.	2300	230/115
100(4)	Al. Ch.	2300	230/115
100(1)	GE	2300	230/460
100(7)	GE	1980	220/440
100(3)	GE	1100	220/440
100(3)	Pitts.	4600	230/115
100(3)	GE	460	115/230
100	GE	11500	230/460
100	GE	11000	2300
100	GE	2400	120/240

MOTORS — MG SETS

— World's Largest Inventory —

We Stock 1200 Units 5 to 75 KVA

ELECTRIC EQUIPMENT COMPANY

ROCHESTER, N. Y.

PHONE: LD-65

RE-MAN-BILT BELYEA MOTORS

THE TRADE MARK WITH A MEANING
SUCCESSFUL OPERATION GUARANTEED
44th YEAR OF SERVICE—MEMBER OF A.R.A.*

MOTOR GENERATOR SET
3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800/4000
2	2000*	G.E.	500	600	6600/11000
3	1500	G.E.	514	250	13200
1	1500	G.E.	720	600	6600/13200
1	1500	Whse.	600	600	2200/4600
1	1500	G.E.	360	375	2200/4400
1	1500	G.E.	600	600	2300/4150
2	1000	Whse.	900	600	2300/4150
1	1000	G.E.	900	260	6600
1	1000(3U)	G.E.	900	250	2400/4600
2	750	Whse.	900	275	2300/4160
1	600	G.E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	350	G.E.	900	125	2300/4150
1	300	A.C.	1200	125/250	2300
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	900	125/250	2300
1	125	G.E.	1200	125	440
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
1	40	Whse.	1200	250	220

*25 Cycle

ROTARY CONVERTERS

1—2000	G.E.	514	600		13800
1—1000	Whse.	900	600		11000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2300/3/60-Exc. & Surface Cond.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
2	1000	G.E.	Non-condensing, 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G.E.	Condensing 125#-725°TT ISP-440 V. 3 ph. 60 cy New—1944
1	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter
2	500	G.E.	Non-condensing, 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
1	400	Whse.	Non-condensing 125/150# ISP 5/10# G.B.P., 240/480v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.

3—1500 KW—250 V. D.C.—13200 V. A.C.
NOW AVAILABLE.

D. C. MOTORS

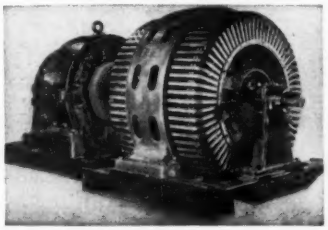
Qu.	HP	Make	Type	Volts	Speed
1—	2500	G.E.	MCF	600	360/500
1—	1750	West.		600	525/720
1—	1500	Whse.		525	600
1—	940	Whse.	QM-R. Brg.	250	140/170
1—	800/1000	Whse.		450	600/720
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G.E.	MCF	550	300/1050
1—	300/400	G.E.	DYNA	250	1325/2500
1—	350	Cr. Wh.	CCM-151H	230	1100
1—	335	Whse.	MQ	250	300/900
1—	200/300	G.E.	MPC	230	360/920
1—	250	G.E.	MPC	230	460/568
1—	200	Rel.	1970T	230	720
1—	150	G.E.		600	250/750
10—	150	Cr. Wh.	93H	230	880
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
2—	150	Whse.	SK-151 B	230	900/1800
1—	50/120	G.E.	MPC	230	250/1000
2—	100	Whse.	SK-181	230	450/1800
2—	80	El. Dy.	308	230	475/1350
1—	60	El. Dy.	258L	230	750/1500

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G.E.	25/60	4000/2300x2300/4000
1—	2000	G.E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G.E.	25/58	4400/2300
1—	500	A.C.	25/60	11000/2300V

SYNCHRONOUS CONDENSERS

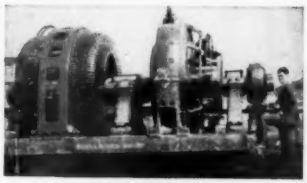
Qu.	Kva	Make	Volts	Speed
1	5000	Whse.	2400/4800	600



500 KW MG SET
IN STOCK

TRANSFORMERS
60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Whse.	Furnace	3	26400/13200x190
3	2000	G.E.	HVDDJ	1	66000x13800
3	1000	G.E.	H	1	2300x480
3	1250	G.E.	H	1	6600x550
1	1150	A.C.	OISC	3	13200x2300/480
3	500	Al. Ch.	OISC	1	11800x3600
1	500	Whse.	OISC	3	13400x216
9	300	G.E.	HT	3	2400x240/480
3	200	Wagner	OISC	1	13800x230/480
3	150	Whse.	OISC	1	33000x2300/4000
3	150	Whse.	OISC	1	34500x238/480
3	100	G.E.	OISC	3	2400x120/240
2	75	Upte	OISC	3	4160x240
1	50	Kuih	OISC	3	4160x240



2000 KW—MG SET
IN STOCK

A. C. MOTORS
3 ph. 60 Cycle
SYNCHRONOUS

HP	Make	Type	Volts	Speed
1—4350	Cr. Wh.		4160/13800	514
2—3500	G.E.	TS	2300	257
1—2500	Whse.		2300	720
3—2100	G.E.	ATI	2300	300
3—2000	Whse.		2300	120
2—1750	G.E.	ATI	2300	3450
3— 735	G.E.	ATI	2200/12000	600
1— 500	G.E.	TS 7657	2400/4800	600
1— 450	Whse.	Eng.	2200	120.5
1— 450	Whse.		2300	450
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 150	Whse.		440	600
1— 100	Whse.		550	600
1— 100	F.M.		220	1200
1— 100	F.M.		440	600
1— 85	G.E.	TS	440	1200

SLIP RING

1—1500	ABB		2300	720
1— 500	Whse.	CW	550	350
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	585
1— 500	G.E.	IM	440	900
1— 400	Whse.	CW	440	514
1— 350	G.E.	MT412-Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
4— 300	G.E.	ITV-5017	550	585
1— 300	Al. Chal	ANY	2200	700
1— 300	A.C.		440	514
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 250	A.C.		550	600
1— 200	Cr. Wh.	26QB	440	885
1— 200	G.E.	IM	440	435
1— 200	G.E.	MTP	440	1170
3— 200	G.E.	IM-17	440	880
1— 200	Whse.	CW	440	490
1— 200	G.E.	IM	440	600
1— 150 new	Whse.	CW	2300	450
4— 125	G.E.	MT-566Y	440/2200	435
1— 100	G.E.	IM-16	2200	435
1— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695
1— 100	G.E.	MT556	2200	900
1— 75	Whse.	CW-761	2200	1735

SQUIRREL CAGE

2— 650	G.E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 300	G.E.	KT-574Y	2300	585
1— 200	G.E.	IK-17	440	580
1— 200	G.E.	KT557	440	1800
1— 200	G.E.	IK	440	885
1— 150	Whse.	CS	440	880
1— 150	Westghse.	CS856B	440	880
1— 125	Whse.	MS	440	425
1— 125	G.E.	KF-TEFC	440	3585
9— 125	Al. Ch.	ABW	2300	1750
1— 100	G.E.	IK-Vert.	2300	480
1— 100	G.E.	KT-513	220/440	1750
2— 100	G.E.	IK	440	580

*American Rebuilders Association — Member Body of A.S.A.

BELYEA COMPANY, INC.

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ELECTRICAL EQUIPMENT

Electrical Equipment ~ Rebuilt and Guaranteed ~ Motors ~ Generators ~ M-G Sets ~ Transformers ~ Controls ~ Electrical Equipment ~ Rebuilt and Guaranteed

REBUILT AND GUARANTEED

PROMPT SHIPMENT — PARTIAL LISTING

250 VOLT DYNAMOMETERS
Cradle Type With Scale and Control
Write for Complete Specifications

Qn.	Make	HP	RPM	Type
1	G.E.	150	2200/5000	TLC-50
1	West.	150	2200/5000	SK-131
1	G.E.	200	1200	C

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-520
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	H-11
2	11‡	820	550	G.E.	ITC-5008
1	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	400	F-M	HV-H16A
2	40	865	2200	Al. Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
1	50	1150	440	G.E.	MT-536
1	50	570	440	G.E.	MT-552
1	60	685	440	West.	CW-738
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	595	550	West.	CW-1002
1	200	495	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
3	300	900	440	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
1	400	595	550	West.	CW
1	600	1770	440*	G.E.	IM-E15C
1	700	745	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. ‡‡25 cycle.
**New. †Also 440 or 550 volts.
Also 2300 volts.

A.C. GENERATORS — NEW
3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding. Direct Connected Exciter.

Qn.	KVA	RPM	Make	Volts
1	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	HP.	Speed	Make	Type
10	3	850	Reliance	T-23T
6	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
2	7½	850	G.E.	CD-75
10	10**	1750	Kimble	AMA-324
5	10**	1150	Al. Ch.	ED-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1450	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-83
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101

230 VOLT ADJ. SPEED D.C. MOTORS

Qn.	HP.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	600/1600	Reliance	T-42T
1	12½	280/840	West.	SK-130
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E	RF-13
1	25	500/1500	G.E.	RF-12
1	25/29	300/1200	G.E.	RF-13
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	West.	SK-163
1	75	375/750	Cr. Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al. Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/600	West.	SK-220
2	375	350/500	G.E.	MPC

**New

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
4	2	1140	220	L.A.	JS-225Y
3	3	1160	440	L.A.	JS-254
4	5	1730	440	G.E.	K-254
2	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
2	20	1760	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W 504

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
4	15	1150	440	L.A.	FX-365
1	50	1760	440	L.A.	FX-445A
4	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
2	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
3	10	3500	440	G.E.	KT-56
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KT-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
1	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
2	60*	1750	440	Ideal	AH-444
1	60	900	440	G.E.	KT-546
1	75	1775	440	West.	CS-505
2	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-352B
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
8	125	1750	2200	Al.-Ch.	AR
1	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2200	G.E.	CS-39A
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/ 4000	West.	CS-4-39D12

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

MOTOR GENERATOR SETS
125 and 250 Volts D.C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220‡
10	West.	1750	125	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	Al. Ch.	1750	125	220/440
50	G.E.	1720	125	220/240‡
75	G.E.*	1200	125	220/240
100	West.	1160	125/250	2300/4100

Note: 3KW, 5KW & 7.5KW, 250V Sets Available
*New. *Synch. Motor Driven. ‡50 Cy. 125 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

43rd YEAR —:— 43rd YEAR
MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE
Partial Listing Only!

GENERATORS—250 V. D.C.

KW	Make	Type	Speed
500	G.E.	MPC	900
300 (2)	G.E.	CY-272	1200
300	Elliott		1200
250	Cr. Wh.	Syn.	1200
200	Delco		1200
150	West.	SK	900
125 (2)	G.E.	MPC	1200
100	West.	SK	1200
75 (2)	Cr. Wh.		1200
50	West.	SK	900
40	West.	SK	1150
40	ABBee	5VG3	1150
30	G.E.	TC93-4	1800
25	G.E.	RC	1150
20	Watton	D	1150
15	Star		1750
10	G.E.	RC	1150
7½	West.	SK	1750

GENERATORS—125 V. D.C.

KW	Make	Type	Speed
150 (2)	West.	SK	1200
100	El. Mchy.	651-T	1200
100	G.E.	RC	1200
100 (3)	West.	SK	900
100	G.E.	MPC	900
75	G.E.	DLC	1150
60 (2)	West.	SK	1800
50	G.E.	RC	1150
50	Cr. Wh.	CCD	1160

GENERATORS—600 V. D.C.

KW	Make	Type	Speed
400 (4)	G.E.	MPC	1200
325	G.E.	MPC	1200

LOW VOLTAGE D.C.

Amp.	Make	Voltage
10000	J-L	2/10
7500 (2)	Nor	7½
5000	MW	6
2500	Chandey.	6/12
500	Chandey.	12
1500	Century	24
500	West.	32
1000	Century	32
1000	Chandey.	40
1500	Century	40
1500	G.E.	50
1000	G.E.	60
1000	G.E.	75

MOTORS—230 V. D.C.

H.P.	Make	Type	Speed
187½	G.E.	MDS	435
150	Sprague	LC	1700
100	Al. Ch.		1150
100	F-M	TRC	725
100	G.E.	RC-36	775
90/45 (2)	G.E.	HP-17	950/450
75	Cr. Wh.	CMC-125H	375/950
60	West.	SK	680
60	West.	SK	950/1088
50	G.E.	CD-93	1000
50 (2)	West.	SK	585
50	G.E.	RF	950/1000

FREQUENCY CHANGERS

KVA	Make	Type	Output Frequency
200	G.E.	ATB	150 cy.
150	G.E.	ATB	150 cy.

MOTORS—Squirrel Cage

H.P.	Make	Type	Speed
250	G.E.	RT559	1750
200	Wagner	RP-2	1800
200	G.E.	KF	880
200 (2)	Al. Ch.	AR	870
200	G.E.	KG	700
150	Wagner	31YRN	900
150	West.	CS	600
125	Al. Ch. (5)	AR	1760
125	G.E.	IK	1150
125	G.E.	KT	1800
100	G.E.	IK	1750
100	West.	CS	1750
100 (2)	Al. Ch.	AR	1750
100	G.E.	K	1175
100	West.		870
75 (2)	West.	CS	1750
75	G.E.	RT	900
75	West.	CS	720

MOTORS—Slip Ring

H.P.	Make	Type	Speed
500	Elliott		1180
500 (2)	G.E.	IM	450
400	G.E.	IM	900
400	West.	CW	435
250	G.E.	IM	435
200 (2)	G.E.	IM	1170
200	G.E.	MT	1175
125	West.	CW	1750
100	G.E.	MT	1150
75	Lincoln		1750
75	G.E.	MT	900
75	West.	CW	690
60	G.E.	MT	1720
60	West.	CW	290

MOTORS—Synchronous

H.P.	Make	Speed
475	West.	720
300	G.E.	900
200 (2)	West.	900
200	Burke	900
180	G.E.	900
165	G.E.	1200
150	G.E.	900
150	G.E.	720
75	G.E.	900

Please Send Us Your Inquiries

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Established 1910
150 GRAND STREET, NEW YORK 13, N. Y.
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The fact that in whatever corner of the United States you might be, you would be within easy reach of O'Brien distribution and service facilities, confirms the acceptance of O'Brien rebuilt machinery and power plant equipment by thousands of satisfied users all over the nation. With a competent, dependable service organization that is linked from coast to coast, O'Brien can service their machinery throughout the entire United States. This means that you can expect precision performance, economical operation and long life from every completely rebuilt O'Brien machine—each thoroughly reconditioned and tested in O'Brien's own shops and O'Brien guaranteed. We have available now the new, used or guaranteed rebuilt machinery you need to expand, modernize, or re-convert quickly, and with minimum capital expense. Inquire today for prices and delivery!

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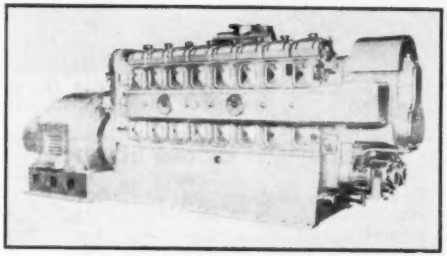
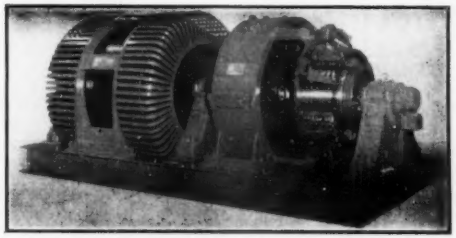


375 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1—1500 KW GE MPC 300 V 5000 Amp.—2150 HP ATI-Syn Motor, 3/60/4000 Volt. Available immediately.
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels.
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #813047 (year 1935) See actual photo above.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.
1—400 KW West. 500 Volt D.C. Any A.C. Voltage with 500 HP West. 350 RPM, 500 Volt Motor for complete drive.
1—360 KW GE CY 125, 180 V., Sep. Exc., 1200 RPM, 500 HP Syn. Mtr., 3/60/2300, 1942.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
1—300 KW Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM —Automatic Controller & D.C. Panel.
2—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.
1—100 KW Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V., 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.

Smaller Sizes and Types—Advise Requirements

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	4000	GE	33000	13200	1
3	1000	GE	13200	2300	1
3	1000	West.	33000	2300	1
1	1000	Penna.	13200	480	1
1	1100	West.	4400	440	3
3	833	GE	13800	460	1
3	750	West.	2300	230	1
3	500	GE	13200	2300	1
3	333	GE	2400	480	1
3	333	GE	13200	2300	1
3	250	West.	13200	2300	1
3	200	GE	7200	120/240	1

OISC TRANSFORMERS (Con't)

2	200	GE	13200	2300	1
3	200	Mal.	2300	220/440	1
3	200	GE	13200	2300	1
3	200	GE	7200	2300	1
3	150	GE	33000	220/440	1
3	150	Niag.	2400	240/480	1
3	100	West.	11000	480	1
3	100	GE	7200	120/240	1
2	100	GE	2300	115/230	1
3	75	Mal.	2300	115/230	1
3	50	GE	13200	120/240	1
3	50	GE	13200	2300	1
4	37½	West.	2400	240/480	1
3	25	West.	2300	115/230	1
3	25	West.	6900	2300	1
2	15	GE	2400	120/240	1
3	10	GE	220	110	1
10	1½	GE	2400	120/240	1

DIESEL & GASOLINE GENERATOR SETS

1—937 K.V.A. GM 12 Cyl. New Engine. Rebuilt Gen. 3/60/480 or 2300.
1—625 K.V.A. Baldwin Series 600—New 1948 —1500 hours. 3/60/2300/514 RPM.
2—438 K.V.A. GM—West. 3/60/2200 360 RPM —New 1937. Complete Plant.
1—375 K.V.A. GM 8-268A, 3/60/480/1200 RPM
1—300 K.W. GM New 8-268A, 230 DC.
1—250 K.V.A. GM Twin 6-71, 3/60/220/440.
1—125 K.V.A. Hercules 3/60/220/440/1500 Hrs
1—62.5 K.V.A. Cummins 6 Cyl. 3/60/220/440.
1—56 K.V.A. Climax Gasoline. 3/60/220/1200.
2—45 K.V.A. Chry. New 6 Cyl. 3/60/220/440.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	West.	CW	2300	450
2	600	West.	CS	2200	600
1	500	AC	ARX	2300	1800
3	500	West.	CS	6600	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	West.	Syn.	2300	1200
1	150	Ideal	Syn.	220	1200
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1800

ELECTRIC MOTORS (Con't)

2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	50	West.	CS	440	3600

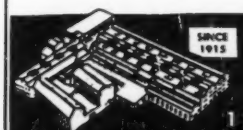
TURBO GENERATORS

1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
2—375 KVA west. Non-Cond. 3/60/440, 125 PSI 5 B.P. New 1938.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 950 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.
2—1400 CFM Sullivan WJ 3 Angle Cpd. 100 psi 22/13x16 belt.
2—1200 CFM I.R. 22/13x16 100 psi belt.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—734 CFM Sullivan W-13 13/13x8 60 lb. belt.
1—528 CFM CP NSB 14x12 100 lb.
1—371 CFM Schramm 7⅛/5x4 100 lb.
1—368 CFM I.R. ER-1 12x100 100 psi.
1—350 CFM I.R. type 40 7/6¼x5 air cooled 125 lb. direct 75 HP 220/440/60/3 870.
1—396 CFM Sullivan type WL-60 100 psi.
1—215 CFM Penna. 3A 10x8 50 lb.
1—173 CFM CP NSB 9x8 100 lb.
1—173 CFM Penna. 3A 9x8 100 lb.
1—122 CFM Worthington 7x7 Horiz. 100 lb.
1—89 CFM CP 6x7 TB 150 lb.
1—40 CFM I.R. Type 30 80 lb. Tank mtd. 7½ HP
3—21 CFM Curtis CJ-1000, 3 stage 850 lb.
5—16.86 I.R. Type 30, 3½/2x5 400 lb.
100—10 CFM I.R. Type N 26 lb. or 25" Hg. Vac.

"Everything from a Pulley to a Powerhouse"



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because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

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PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1230	Nordberg	F6G168SC	1750	327
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
350	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200
30	Inter. Harvester	UD-14	45	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR **GUARANTEE!**

TURBINE GENERATOR UNITS
3 Phase 60 Cycle

25000 KVA G.E. Cond. 250 lbs. 13200 volts.
21500 KVA G.E. Cond. 250 lbs. 2400 volts.
18750 KVA A.Ch. Cond. 200/400 lbs. 13200 volts.
6250 KVA A.Ch. Cond. 200 lbs. 4160 volts.
5000 KVA G.E. Non-cond. Extr. 600 lbs.—125 lbs. Extr. 50 lbs. Exh. 13800 volts.
5000 KVA West. Cond. Extr. 400 lbs.—50 lbs. Extr. 600 volts.
5000 KVA G.E. Cond. 400 lbs. 2300/4000 volts.
2500 KVA West. Cond. 250/400 lbs. 2400 volts.
1563 KVA G.E. Cond. Extr. 200/400 lbs—10/20 lbs. Extr. 2400 volts.
1250 KVA West. Cond. 450 lbs. 2400/4160 volts.
750 KVA Murray Non-cond. 250 lbs.—30 lbs. Exh. 240 volts.
625 KVA G.E. Non-cond. 150/400 lbs.—50 lbs. Exh. 2300 volts.

ENGINE GENERATOR UNITS
3 Phase 60 Cycle

770 KVA Skinner Uniflow, 150 lbs. 2300 volts.
750 KVA Ames Vert. Uniflow, 150 lbs. 4160 volts.
625 KVA Skinner Vert. Uniflow 150 lbs. 480/240 volts.
312 KVA Skinner Uniflow, 150 lbs. 480/240 volts.

DIESEL GENERATOR UNITS
3 Phase 60 Cycle

1000 KVA DeLaVergne, 2400 volts, 200 rpm.
875 KVA DeLaVergne, 2400/4160 volts, 327 rpm.
700 KVA Fairbanks-Morse, 2400 volts, 300 rpm.
600 KVA Fairbanks-Morse, 2400 volts, 300 rpm.
475 KVA Cooper-Bessemer, 2400 volts, 400 rpm.
300 KVA Worthington, 208-120 volts, 450 rpm.

GENERATORS
3 Phase 60/240 Cycle

7500 KVA G.E. 60 cy. 13800 volts, 720 rpm.
4600 KVA G.E. 90 cy. 2400 volts, 5400 rpm.
2859 KVA (3) G.E. 180/240 cy. 2300/4150 volts, 3600/4800 rpm.
2500 KVA G.E. 60 cy. 2400/480 volts, 3600 rpm.

STEAM BOILERS

100,000 lbs. per hr. Badenhausen, 170/700 lbs. pulv. coal.
50,000 lbs. per hr. B. & W., 420 lbs., pulv. coal.
30,000 lbs. per hr. B. & W., 435 lbs., gas or oil.
20,000 lbs. per hr. B. & W., 175 lbs., stoker coal.

TRANSFORMERS
60 Cycle

1,000 KVA (3) West. 1ϕ, 6900/11950-2300 volts.
750 KVA Mol. 3ϕ, 13200-2200 volts.
667 KVA (3) Mol. 1ϕ, 19920/34500-2400 volts.
600 KVA (3) G.E. 3ϕ, 11000/22000-2300/460 volts.
500 KVA (3) Mol. 1ϕ, 44000-33000 volts.
500 KVA (3) West. 1ϕ, 13800-2300 volts.
500 KVA (4) Mol. 1ϕ, 19920/34500-2400 volts.
500 KVA (3) West. 1ϕ, 33000-2300/4000 volts.
333 KVA (3) G.E. 1ϕ, 33000-3300 volts.
150 KVA (3) West. 1ϕ, 19050/33000-2300 volts.
100 KVA (3) West. 1ϕ, 33000-240/480 volts.

SYNCHRONOUS CONDENSER

7,500 KVA G.E., 3 phase, 60 cycle, 13800/6900/4000/2300 volts, 720 rpm.

INTERNATIONAL POWER MACHINERY CO.

1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

JULY, 1952

CHICAGO Electric Digest

PUBLISHED BY CHICAGO ELECTRIC CO. • THE HOME OF GUARANTEED REBUILT POWER EQUIPMENT

GUARANTEED REBUILT EQUIPMENT AID TO INDUSTRY

SQUIRREL CAGE

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
1000	*G.E.	K6347S	1800
750	*G.E.	KT	720
500	*G.E.	PGB	1800
450	*G.E.	KP567S	1200
400	*Continental	NZ	1200
400	A.C.	ANW	900
400	*G.E.	IK	514
350	*Cr.-Wh.	SC	3600
300	*Westgh.	CS	3600
300	G.E.	IE-K	1200
300	A.C.	AR	900
250	A.C.	630DSWW	1200
250	*L. Allis	OGX1488	720
250	G.E.	IK	600
200	*G.E.	FT549Y	3600
200	*G.E.	IK13B	1800
200	*A.C.		720
200	A.C.	ARWWT	600
200	G.E.	IK17	600
150	G.E.	KT346	1800
150	*A.C.	AN	1800
150	G.E.	IE-K	1800
150	*G.E.	IK	600
125	*A.C.	AR226	1800
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	A.C.	AW	1200
100	G.E.	IK15A	1200
100	U.S.	CFU (Vert)	1200
100	*Westgh.	CS (Vert)	1200
100	A.C.	AR	900
100	G.E.	IK15A	514
75	A.C.	AN	1800
75	Westgh.	CS645C	1800
75	G.E.	KT346	1200
75	Westgh.	CS	900
75	A.C.	AR (Vert)	900
75	G.E.	IK	600
75	Triumph	TR16	514
75	G.E.	IK	514
60	*Westgh.	CS504S	1800
60	A.C.	APZ445S (TEFC)	1800
60	A.C.	APZ504U (TEFC)	1200
60	Armor	AB51	1200
60	A.C.	AR823	900
60	A.C.	AR826F	514
50	G.E.	K404	3600
50	Westgh.	CS445	1800
50	G.E.	KT527	1800
50	U.S.	SCV937 (Vert)	1800
50	G.E.	KT343	1200
50	Howell	K504 (TEFC)	1200

Hundreds of Smaller Motors!!

SPECIAL

110 NEW Hi-Torque—Hi-Slip Motors 3/60/220/440, BB, Staright Shaft 1 — 1½ — 2 — 3 — 5 — 7½ HP. Speeds —1020 to 1135 RPM. OPEN and TENV. Less than HALF of your usual Cost

D. C. MOTORS

Mill Type—Pedestal Bearing—Reversing

HP	Make	Volts	Speed
3000	West. (Tandem)	525	600
1750	West.	600	550
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

230 Volts—Constant Speed

H.P.	Make	Type	Speed
375	Westgh.	Fed	650
200	Westgh.	SK210	800
175	G. E.	ELC11	750
125	G. E.	Marine	1200
100	G. E.	RC34	2500
100	Westgh.	SK173	850

CRAFTSMANSHIP MEANS QUALITY

100	A. C.	E182	575
40	Cr.-Wh.	CMC	1800
40	G. E.	CO2004	500
35	Cr.-Wh.	CM351	700
30	Westgh.	SK93	1750
30	Westgh.	SK120	975
30	Cr.-Wh.	CCM	450
25	G. E.	CD93	1150
25	Westgh.	SK100L	1100

MANY OTHERS—1 HP and Up! Also 115 Volt

SLIP RING

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
500	Westgh.	CW	350
400	A.C.	3 Brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	Westgh.	HF15H	600
200	Westgh.	CW	600
200	G.E.	IM	1800
150	Westgh.	CW772C	1200
150	*G.E.	IM-16	600
125	*G.E.	MT-549	1800
125	G.E.	IM17A	600
100	A.C.	ANY	900
100	G.E.	IM	450
75	G.E.	MT547	1200
75	G.E.	MT356	900
75	G.E.	IM	720
75	Star	OSOO	900
60	Westgh.	CW762C	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	Westgh.	CW636A	1200
50	G.E.	MT346	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT336	1200
40	Westgh.	CW642C	1200
35	G.E.	IM	1200
30	G.E.	MT532	900
25	G.E.	IM11	1200
20	G.E.	MT512	1200
15	L.Al. (new)	OH326	1800

Hundreds of Smaller Motors

HI-PRESSURE

PUMPS

GPM	Make	Type	Head
800	Worth	6DS	925 ft.
500	Manistee	H	250 ft.
300	Al.-Ch.	NMZ	800 ft.

CHANDEYSSON ANODIZER
NEW 1000 Amp. 40 volt, type NPT, 6 to 60 HP A-28 Syn. Motor, 3/60/220, 600 RPM. 25° C. continuous.

AC SYNCHRONOUS

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	R.P.	Speed
1420	*Westgh.	Syn.	0.7	900
800	G. E.	TS984	1.0	1800
700	*G.E.(New)	TS975Z	1.0	1200
320	*A. C.	Syn.	1.0	720
300	G. E.	ATI	0.8	900
300	*G. E.	ATI	1.0	720
300	*Ideal	SMM	0.8	257
250	*A. C.	Syn.	0.8	720
150	*Westgh.	HR	1.0	300
125	Parkinson	Syn.	0.9	900
125	*El. Ma.	Syn.	1.0	900
125	Cr.-Wh.	103S	1.0	900
125	*G. E.	TS	1.0	277
115	El. Ma.	EM	1.0	240
100	Cr.-Wh.	103S	0.8	900

AC SYNCHRONOUS

GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

KVA	Make	Type	P.F.	Speed
3500	*G. E.	ATI	0.8	720
1750	*Westgh.		0.7	900
1500	G. E.	ATI	0.8	720
250	*A. C.		0.8	720
112½	*G. E.	ATB	0.8	1200
110	Cr.-Wh.	103	0.8	900
100	*G. E.	ATB	0.8	900
60	F-M	B	0.8	900
55	G. E.	ATB	0.8	1200
50	G. E.	ATB	0.8	1200

PHONE: CANAL 6-2900

CHICAGO Electric Co.

1320 West Cermak Road, Chicago 8, Ill.

CHICAGO ELECTRIC EXPERTS DO OUTSTANDING JOB

For over 42 years, Chicago Electric has been a leader in the rebuilding of electrical power equipment. This record of business is positive testimony to the exacting standards and high quality of the Chicago Electric rebuilding work. Equipment is rebuilt to perform "like new" and fully guaranteed. Whatever your needs be sure to check with Chicago Electric first.

A COMPLETE SERVICE

***Chicago Electric* offers a complete service to industry that covers, REWINDING, REPAIRING, REBUILDING, REDESIGNING, COILMAKING, SPECIAL MACHINING, POWER SURVEYS POWER-FACTOR CORRECTION and RENTAL of equipment.**

M. G. SETS

K.W.	Make	A.C.	D.C.
2400	A-C (3-unit)	4800/2400	525
2400	West. (3-unit)	4800/2400	600
1000	G. E. (3-unit)	11000	137½/275
1000	West.(3-unit)	11000	137½/275
750	A. C.	440	250
500	Al. Ch.	2300	250
500	Cr.-Wh.	220/440	250
450	G. E. (3 unit)	2300	125/250
250	West.-G. E.	440	250
200	Ridgeway	2200	250
150	G. E.	2300/440	250
150	G. E.	440	250/275
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	G. E. Delco	440	120/240
75	Al. Ch.	440	250
60	Al. Ch.	2300	110
40	Cr.-Wh.	220	125
35	G. E.	440	125
25	Westgh.	2200	125
20	G. E.-Bogue	440	125
20	G. E.-Bogue	550	250
20	G. E.	440	250
15	G. E.	220	250
10	G. E.	440	125

DC to AC, 3 Phase, 60 Cycle

KVA	Make	DC	AC
100	G.E.	235	230
75	Westgh	110	2300
12½	Westgh	115	240

ENGINE-GENERATOR SETS

KVA	Make	Type	Volts	RPM
300	Gen. Mot.	8-268A	480	1200
100	Gen. Mot.	5-268A	480	1200
100	Gen. Mot.	671	480	1200
31	Cummins	HI-6	120/208	1200
25	LeRoi	20-A	120	900
10	Onan	PE35G	115/230	1800
1½	Kohler	D-7551	110 DC	1000
1	Onan	10L-108	115	

TRANSFORMERS

KVA	Make	Ph.	Pri.	Secondary
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
450	G.E.	3	2300/4000	230/460
300	G.E.	3	13800	240/480
300	G.E.	3	2400	240/480
200	Wagner	1	2400	575
167	A.C.	1	2400	120/240
100	Pitts.	1	2400	575
100	A.C.	1	2400	120/240
50	Sorgel	1	2400	120/240

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—9375 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1—6250 KVA Allis Cond. 60 cy. 4000 V. 175-200 lb.
1—5000 KVA West. Cond. Extr. 60 cy. 480 V. 385-lb.
1—3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1—2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1—2500 KVA G.E. Cond. 60 cy. 600 V. 175-lb.
1—1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1—1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1—1563 KVA G.E. Extr. Cond. 60 cy. 2300 V. 200-lb.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 928 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 938 KVA West. Extr. Cond. 60 cy. 2300/4100 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 750 KVA G.E. Cond. 60 cy. 2300 V. 150-lb.
1— 625 KVA Worthington Non-C. 60 cy. 480 V. 125-lb. 10-lb. BP
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.

DIESEL ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1— 600 HP Enterprise 440 V. 60 cy.
2— 500 HP Winton 2400 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

2—500 KVA Ames Vertical Uniflow 2300 V.
1—250 KVA Ames Vertical Uniflow 480 V.
1—200 KVA Skinner Uniflow 230 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	2000	G.E.	600	4000	450
1	1500	G.E.	600	4150	600
2	1000	West.	600	4150	900
1	500	West.	125	2300	720
1	200	West.	275	2200	900
1	150	G.E.	250	2300	1200
1	150	West.	275	440	900
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
2	700	West.	2300	200
1	600	G.E.	2300	1800
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	500
1	1700	West.	60/24	720
1	625	A.C.	25/80	300

OIL CIRCUIT BREAKERS—Outdoor

1— 600 A. 73 KV G.E. FHKO-236-500
1— 400 A. 37 KV G.E. FHKO-136-250
1— 400 A. 37 KV G.E. FHKO-236-500
1— 600 A. 15 KV G.E. FHKO-139-750
2— 600 A. 15 KV G.E. FHKO-136-1328 BS
1—1200 A. 15 KV G.E. FKO-139-340
1— 600 A. 15 KV G.E. FKO-138-350
2— 600 A. 15 KV G.E. FLO-15-250

TRANSFORMERS

3—	75 KVA A.C.	68000/24000—7200/12470 Y	
3—	150 KVA G.E.	44000—7200/12470 Y	
1—	100 KVA G.E.	44000—2300	
1—	75 KVA West.	44000—7200/12470 Y	
3—	8333 KVA West.	41800—13800	
2—	900 KVA G.E.	36300—2300, 3 ph.	
1—18750 KVA A.B.B.		34819—11000, 3 ph.	
3—	150 KVA Wag.	33000—7200/12470 Y	
3—	100 KVA A.C.	33000—7200/12470 Y	
3—	100 KVA West.	33000—240/480 NEW	
3—	75 KVA Wag.	33000—7200/12470 Y	
6—	450 KVA A.C.	25410/44000—13200/23000	
3—	1250 KVA G.E.	23000—2300/4000	
3—	800 KVA G.E.	22000—2300	
3—	100 KVA G.E.	22000—7200/12470 Y	
9—	50 KVA G.E.	22000—2300	
6—	200 KVA G.E.	13200—2300	
2—	200 KVA G.E.	11500—220/110	
3—	200 KVA Mol.	11000—2300	
3—	250 KVA Pitts.	7200—220/440	
3—	200 KVA Wag.	7200/12470 Y—2400	
3—	500 KVA Pitts.	6900/11900—550	
3—	333 KVA Pitts.	6900/11900—550	
3—	150 KVA Wag.	6900—2300	
1—	100 KVA G.E.	6900/11900—2400	
3—	37½ KVA G.E.	6900/11900—2400	
1—	37½ KVA G.E.	6900—230/460	
3—	333 KVA G.E.	2300—230/460	
1—	100 KVA G.E.	2300—575, 3 ph.	
3—	100 KVA West.	2300—230/460	
3—	75 KVA Mol.	2400—120/240	
6—	50 KVA West.	2400—115/230 DRY TYPE	
3—	15 KVA Stand.	450/225—117 DRY TYPE	

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, — WOrth 4-1470

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

FOR IMMEDIATE DELIVERY

TURBO-GENERATORS—Condensing—500 to 20,000 KW; some extraction type, pressures 200 to 450#

TURBO-GENERATORS—Non-condensing—300 to 3000 KW. 150# to 450#, some extraction with high back pressure

STEAM GENERATORS—30000# to 100000# per hr. 150# to 450#

BOILERS—Water Tube, Stirling & Straight Tube types 200 to 450#

BOILERS—Fire Tube, 100 to 300 HP. 100 to 250#

TRANSFORMERS Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators, Rotaries, Frequency Changers, Large Motors & Diesel Generators.

Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK — 30 CHURCH ST. — NEW YORK 7, N. Y.

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. — St. Louis 1, Mo.

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-6075	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open

NEW SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed	Description
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	CS-5045	1800	TEFCBBXP
60	G.E.	K-5945	1800	TEFCBBXP
60	L.A.	OG-44	1800	B. B. open
60	F.M.	QS-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-505	900	TEFCBBXP
40	A.C.	AR-444	3600	TEFCBBXP
40	G.E.	KF-3605	3600	B. B. Splash
40	West.	CS-405	1800	TEFCBB
40	L.A.	K-405	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open

SQUIRREL CAGE MOTORS REBUILT

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.

REBUILT SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed	Description
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We hav ein stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.

We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

8 CAIRN ST.—P. O. BOX 534—ROCHESTER 2, N. Y.—Telephone: Genesee 5629

MOTORS - M.G. SETS - CONTROL

NEW AND GUARANTEED REBUILT

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
600	1800	2300	G.E.	100%
400	900	2300	Whse.	80%
200	900	440	E-M	80%
150	200	440	G.E.	80%
150	900	440	G.E.	100%
150	900	2300	G.E.	100%

SLIP RING

HP	RPM	Volts	Mfg.
700	514	2300	G.E.
500	1200	220/440	Elliott (new)
350	450	2300	Whse.
200	450	2300	Burke
100	1160	440	G.E.
75	720	220	G.E.
50	720	220	Whse.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
250	240	2300	G.E.
150	250	440	Whse.
100	275	2300	Whse.
50	250	440	G.E.
40	250	220/440	G.E.
30	125/250	2300/4000	G.E.
7½VS	230	220/440	Rel.
3VS	250	220/440	Rel.

CRADLE TYPE DYNAMOMETERS

1—225 HP, Whse., 250 v. D.C., 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

1—150 HP, Whse., 275 v. D.C., 3000/5000 RPM, Frame 121, complete with all necessary control.

NEW MAGNETIC SLIP RING CONTROL

1—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

D. C. CONTROLS 230 volts

2—200 HP G.E. magnetic reversing, dynamic braking starters.
1—125 HP Clark magnetic adjustable speed starter.
1—New 100 HP Monitor magnetic, adj. speed starter.
1—Westinghouse 75 HP, reversing, dynamic braking starter.
2—New 75 HP C-H Bul. 6130H92 plain magnetic starters.
1—50 HP Ward Leonard mag. adj. speed starter, dyn. braking.
2—40 HP G.E., magnetic, reversing, dynamic braking starters.
1—New G. 30 HP variable voltage controller CR 3270Y1, reversing, aynamic braking.
1—30 HP G.E. Planer Control CR 4630Y1, reversing, dyn. braking.
1—25 HP Westinghouse Class 8522 magnetic adj. speed starter.
6—New 15 H PWestinghouse plain magnetic starters.
3—5/7½ HP G.E. CR 4065 magnetic, dynamic braking starters.
4—5 HP C-H Bul. 6130 plain magnetic starters.

(We can assembly any type D.C. control to your specifications)

NEW DIRECT CURRENT

230 volt-dripproof

Qu.	HP	RPM	Mfg.	Frame
5	5	850/1700	G.E.	CD-66
3	7½	575/1725	G.E.	CD-77
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg.	Brgs.
100	450/1350	Whse.	SI.
65	400/1200	Rel.	SI.
50	300/900	G.E.	SI.
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S.SI.
30	350/1050	Whse.	SI.
30	500/1500	Rel.	Ball
30	600	Whse.	SI.
25	300/1200	Rel.	Ball
25	500/1500	C-W	Ball
25	600/1350	Rel.	Ball
20	250/1000	Whse.	SI.
20	300/1200	Rel.	Ball
20	500/1500	G.E.	SI.
15	250/1000	G.E.	SI.
15	300/900	G.E.	Ball
15	400/1600	Whse.	SI.
15	575/1725	L.A.	Ball
15	650/1500	G.E.	SI.
15	700/1350	Rel.	Ball
10	300/1200	Whse.	SI.
10	400/1600	Whse.	SI.
10	850	Rel.	Ball
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	Ball
7½	400/1600	Whse.	Ball
7½	600/1800	Rel. (TE)	Ball
5	400/1200	C-W	SI.
3	850/1700	Rel.	Ball

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

DIESEL and GASOLINE

Engines and Generator Sets
1 to 2000 KW

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Nordberg Distributors

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EVerglade 4-4511

MOTOR GENERATORS

1—400 KW G.E. Syn. 600 V. 720 RPM
2—300 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW RIDGWAY Syn. 250 V. 1200 RPM
1—240 KW G.E. Syn. 250 V. 1200 RPM
1—225 KW G.E. Syn. 125 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 900 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
1—100 KW RIDGWAY Syn. 250 V. 1200 RPM
1— 50 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM
1—500 KW WEST. 250 V. 1200 RPM
2—500 KW Al-Ch. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

BARGAINS

1000 KW, 3 phase, 60 cycles, 480 volt General Electric Generator to a turbine designed for 200 lbs. pressure, 15 lbs. extraction, complete with condensor, pump and complete switchboard.

2—2000 amp., 3 pole, 15000 volt type FKR 255 B Gen. Elec. solenoid operated oil switches.

4—1600 amp., 3 pole, 15000 volt, type B 26 Westgh. solenoid operated switches.

We carry a large stock of all kinds of transformers, motors, etc. What have you for sale? What do you need?

KEYSTONE POWER PLANT EQUIPMENT CO.
8403 Hegerman St., Phila. 36, Penna.

NORDBERG UNIFLOW ENGINE AND GENERATOR

Generator	ALLIS-CHALMERS	Control equipment	
Power factor	80%	Engine	NORDBERG UNIFLOW
Maximum capacity	312 KVA	Serial number	38211
Volts	220	Cylinder sizes	18" x 32"
Phase	3		
Cycle	60	Steam pressure	150-200 lbs.
RPM	150		
Belted exciter		Non-condensing	

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1923 W. North Ave. Chicago, Ill.

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ASH AND COAL HANDLING EQUIPMENT

Complete System

Beaumont Coal-Weighing Larry, with 2-Ton Buffalo Scale
55-Ton Coal Drag Scraper Winding Machine
35-Ton Cap Skip-Hoist Winding Machine
12-Ton Cap Ash Skip-Hoist Winding Machine
Track Hopper Ash Gate Hydraulic System
Coal and Ash Bunkers
Also Motors, Controls & Accessories

Will Sell All or Any Part

ACORN IRON & SUPPLY CO.
915 No. Delaware Ave., Philadelphia 23, Pa.

GET MORE FOR YOUR MONEY FROM HEMPHILL GUARANTEED EQUIPMENT

GUARANTEED GOOD BECAUSE REBUILT AND TESTED BY HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph.	Voltages
1	1500	Penna.	OISC	3	4150x2400
1	1500	GE	Pyranol	3	4150x2400
1	500	Kuhl.	OISC	1	4600x2300
2	400	Pitts.		1	2400/4800x240/480
1	333	GE	OISC	1	11200x220/440
1	200	GE	HT	3	2300x220
1	200	Pitts.	ODSC	1	4600x110/220
1	200	Mol.	C	1	2300x220/440
3	100	Wagner	HEB	1	240x120/120
1	100	Amef.		1	11500x2300
3	100	GE	Auto	1	415eYx2400Y
9	50	GE	H	1	13750x125x216Y
1	50	Al. Ch.	ODSC	1	13550x120/240
2	50	Pitts.	Sub	1	13550x120/240
1	50	Amer.	OISC	1	6600/11200x220/440
1	50	Amer.	WF	1	240x240/30
1	50	GE	KS	1	2300x270
1	50	Amer.	AT	1	220/220/44
1	37½	GE	H	1	2200x110/220
1	37½	Amer.	RS	1	6900/12800x220/440
1	37½	Amer.	OISCID	1	6600/11200x220/440
2	37½	Amer.	AT	1	220x220/44

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2300
1	200	El. Prod.	277		4150
1	150	GE	720	ATI	2300
1	150	GE	1800	TS	220
1	150	Whse.	900		220

Member of the National Industrial Service Assn., Inc.

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
2	1000	GE	514	600	2300/4150 Syn.
1	200	Whse.	900	250	220/440 Syn.
1	150	GE	120	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	220/440 SC
1	100	GE	900	250	2300 Syn.
1	94	GE	1200	60	440 SC
1	94	GE	1200	60	4150 Syn.
1	30	GE	900	230	220 Syn.

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	1750	GE	4160	K	3600 Sq. Cg.
1	500	GE	440	IM	900
1	250	Whse.	600	CW	440
1	200	GE	1800	MT	2300
1	200	Whse.	600	CW	440
1	200	GE	600	MT	440
1	100	GE	900	IM	440

SPECIAL - WELDING

1—150 KVA GE, type KWC, 1 ph., 550 V, sec. 12.22/6.05 V. Thryatron Spot and Seam, Control CR 7503

SLIP RING MOTORS—(Con't)

1	75	GE	1200	MT Vert.	220
1	60	GE	1750	MT	220
1	60	GE	900	MT	440
1	50	GE	1720	MT	220
1	50	Whse.	900	CW	220
1	50	GE	1700	MT	220
1	50	GE	600	MT	220
1	40	GE	1200	MT	220

TURBO GENERATOR

250 KVA Elliott 208V 200≠ non-cond.

SPECIAL M.G., A.C. WELDER

1—176 KVA Whse., 220 V, 57 PF, 1200 RPM, 1 ph., with 75 HP Slip Ring, 440V, type CW, Exc. & Control

"FOR POWER"
J.L. HEMPHILL & CO.
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PHONE NEW YORK - LONGACRE 5-3727
PHONE NEW JERSEY - UNION 7-2[illegible]

-TRANSFORMERS-

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries. New Transformers built to your specifications.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.
One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

DIESEL ENGINES

1800 HP Fairbanks-Morse, Model 38D 8-1/8, 8-1/8" x 10", 800 RPM, 10 Cylinder, air start, solid injection, complete with auxiliaries. *Excellent condition.*

480 HP Buckeye Diesel engine, 8 Cylinder, Model 80, 600 RPM, late type. *Rebuilt.*

Other sizes in stock

ALJON ELECTRIC DIESEL CO.
904 Pacific St., Brooklyn 16, N. Y.
STerling 3-6515

REBUILT GUARANTEED POWER EQUIPMENT

MOTOR GENERATOR SETS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	2300/440
400	West.	720	550	2360/4000
300 (2)	West.	1200	250	2300/4000
300	G.E.	1200	250	2300/4000
200	G.E.	1200	250	2300/4000
150	G.E.	900	550	2300/4000
150	G.E.	1200	250	2300/4000
100	G.E.	1200	250	2300/4000
75	West.	900	75	440
50	G.E.	1200	125/250	220/440
35	G.E.	1800	125	220/440
15	Ideal	1800	125	220/440

ROTARY CONVERTERS

KW	MAKE	RPM	D.C.	Transformer
500	West.	1200	250	11450/9900
400	West.	1200	250/125	13860
300 (2)	Al. Ch.	1200	250	2300/4000
300	G.E.	600	250	2300/4000
200	G.E.	1200	250	2300/4000
150	G.E.	1200	250	2300/4000

Will rewind above transformers to your requirements

PLATING M-G SETS

4—1500/3000 Amp. 6/12 V.—A.C. Motors

A.C. MOTORS

HP	MAKE	RPM	TYPE	WDG.
400	G.E.	450	MT	S.R.
300	G.E.	450	IM	S.R.
200	G.E.	600	IM	S.R.
150	G.E.	600	ATI	Syn.
100	G.E.	450	IM	S.R.
100	West.	1200	CS	S.C.
100	West.	900		Syn.
100	G.E.	1750	IK	S.C.
60	West.	575	CW	S.R.
50	G.E.	1750	KT	S.C.
50	Al. Ch.	1200	AR	S.C.
50	G.E.	900	KT	S.C.
30	G.E.	900	KT	S.C.
30	G.E.	1200	KT	S.C.
20	West.	1200	CS	S.C.
15	Al. Ch.	1800	AR	S.C.
15	Al. Ch.	1200	AR	S.C.

TRANSFORMERS 1 PH. 60 CY.

	KVA	MAKE	PRI.	SEC.
1—	3000 (3 ph)	G.E.	23000	22000
2—	200	Al. Ch.	22900	2200
3—	100	West.	2400	240/480
1—	50	West.	2400	240/480
2—	50	Al. Ch.	2200	110/220
1—	25	West.	6600	110/220

D.C. MOTORS

HP	MAKE	TYPE	VOLTS	SPD.
300	Cr. Wh.	CCD	230	1100
300	West.	SK	230	300
220	West.	SK	230	175
150	G.E.	DLC	230	800
60	West.	SK185	230	435
50	West.	SK113	230	1750
50	Rel.	T185	230	1700
50	El. Dy.	S50	230	190/760
30	West.	SK93	230	1750
25	Rel.	T310	230	400/1600
25	West.	SK113	230	875
20	Rel.	T262	230	400/1600
20	West.	SK83	500	1750
15	West.	SK113	230	825
10	West.	SK100L	230	400/1600
10	West.	SK80	230	730/1460
10	West.	SK60L	230	1150
10	West.	SK70L	230	850
5	West.	SK70	230	400/1600

AIR COMPRESSORS—HOISTS

142 CFM Ing. Rd. 100≠ pressure, belted 30 HP
356 CFM Chic. Pneu. 12"x10" 100≠ Pressure.
½ Ton—AC American
1 Ton (3)—DC Shepard
3 Ton—AC with motor trolley
4 Ton—DC Brown

Mailing Address—Pittsburgh 16, Pa., P. O. Box 7991P *(Power Specialists Since 1919)* *Office and Shop*—Oakdale, Pa.

MOORHEAD ELECTRICAL MACHINERY COMPANY

REBUILT POWER EQUIPMENT—READY TO SHIP!

FOR SALE or RENT
SPECIAL BARGAINS
DIESEL ENGINE GENERATOR SETS

4—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-3, 5½ x 7, 8 cyl., Superior Diesel Engines, elec. start, power panel, accessories. Practically new—only used for spares.
1—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. Gen. dir. con. to 150 HP. Superior Diesels same as above.
1—96 kva. Fairbanks Morse 220/440 V. 3 ph. 60 cy., 360 rpm. DIESEL.
1—37½ kva. 3 ph. 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A.C. Generators with dir. con. exciters driven by 70 HP., 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.
2—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 58 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.
3—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels.
17—7½ KW., 120 V. 1 ph., 60 cy. Continental Gas Engines.
2—New 5000 Watt—115/230 V., 1c, 60 cyl. Wisconsin Gas Engines.

DC VARIABLE SPEED MOTORS
230 Volts

HP	MAKE	RPM	TYPE
400	All. Chal.	400/1200	
125	Westg.	125/500	RB Anti-Fric.
100	Westg.	500/1000	SP BB
75/150	G.E.	300/1200	CD-189 BB Enc.
75/100	Westg.	600/1200	SA-13L SB
50	G.E.	600/1200	LC
50	Reliance	400/1600	T-985F TEFC BB
50	Reliance	300/1200	T1985T BB
50	Crkr. Whlr.	1200/200	CMC-SB
40/50	Reliance	500/1500	T-461T BB
40	Westg.	750/1500	SK-140
40	Al. Chal.	575/1150	E-145
40	Reliance	500/1500	T-461F TEFC BB
40	Reliance	400/1600	T-615F TEFC BB
40	El. Gen. Co.	385/1200	Frame 180S
35	G.E.	625/2100	COM-1829 AE
35	G.E.	350/1400	RF-162 SS
30/40	Imperial	400/1600	D-D69 BB DP
30/40	Reliance	300/1200	T-651 TE BB
30	Westg.	1150/1750	SK-135 TEFC BB
30	Reliance	400/1600	T-561F TEFC BB
30	Imperial	400/1600	D-D69 BB DP
25	Reliance	400/1600	T-310F TEFC BB

DC VARIABLE SPEED MOTORS (Cont.)

25	G.E.	300/1200	CD-123
20/25	Reliance	400/1600	T-262T DPBB
20	Westg.	750/1500	SK-110-L
20	Westg.	625/1250	SA-6
20	Reliance	600/1200	T-131T BB
20	Westg.	565/1130	S-8
20	G.E.	500/1500	RF-11 SB
20	Reliance	400/1600	T-262T TEFC BB

IMMEDIATE DELIVERY
AIR COMPRESSOR

876 cfm Chicago Pneumatic 100 lb. pressure 2300 or 440 v. A.C. syn. motor complete with starting equipment.

TRANSFORMERS—1 Ph. 60 Cy.

No.	KVA	MAKE	PRIM.	SECONDARY
4	15	G.E.	2200	110/220
10	25	G.E.	2200	110/220
3	25	West.	2200	110/220
1	30	G.E.	2200	110/220
9	37½	G.E.	2200	110/220
2	40	G.E.	2200	110/220
11	50	G.E.	2200	110/220
3	50	West.	2200	110/220
3	75	West.	2400	120/240
1	75	West.	13200/6600	2300
1	75	Pgh.	4600	115/230
1	100	Pgh.	2300/4600	115/230
6	100	Pgh.	4600	115/230
1	100	West.	2200	230/460
2	150	Pgh.	4600	115/230
1	150	G.E. (3 Ph)	2200	240/480
3	200	All. Chal.	22000	2300
3	200	Pgh.	25000	460
2	250	G.E.	2400	480

AC MOTORS
220/440 Volt—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
525	Elliott	720	Syn.
450	Elliott	720	Syn.
350	West.	585	CS
300	G.E.	1800	KT-563
250	G.E.	515	KF-TEFC
250	Burke	720	Syn.
250	G.E.	1150	IE-15
225	Elec. Machy.	1800	Syn.
200	West.	291	CS
200	G.E.	430	KF-TEFC
200	G.E.	860	IE-15
200 NEW	G.E.	1150	KG Hi Torque
200 (6)	Wagner	1800	RP-2

AC MOTORS — Cont.

200	G.E.	1800	Syn.
150	West.	257	Syn.
150	G.E.	400 (2300 V.)	KF
150	G.E.	400	KF-TEFC
150	West.	600	Syn.
150	Cr. Wh.	860	
150 NEW	Reliance	1200	AA
150	G.E.	1200	2200
150	G.E.	1200	KT-562
150	Elec. Machy.	1800	Syn.
150	Reliance	1800	BB
150 (2)	G.E.	1775	KF
125	G.E.	164	Syn.
125	Cr. Wh.	720	
125	Wagner	1150	RP-2
125	West.	1800	CS-761C
100	Cr. Wh.	600	
100	G.E.	900	I-K
100	Wagner	860	RP-2
100 NEW	Reliance	1170	TEFC
100 NEW	Reliance	1170	BB
100	West.	1800	Syn.
100 NEW	Reliance	1760	TEFC
100	West.	1750	CS
100	G.E.	1750	K-504
100 NEW	Reliance	1765	BB
100	West.	1800	Syn.
75 NEW	Reliance	875	AA-5084
75	Elec. Machy.	900	Syn.
75	West.	1200	CS
75	G.E.	1150	KT-542
75	Wagner	1200	RP
75 NEW	Reliance	1150	AA-505
75 NEW	Reliance	1150	TEFC
75	West.	1750	CS-504
75 NEW	Reliance	1760	TEFC
75	Reliance	1750	AA-505S
75	Louis Allis	1800	Splash Proof
60	G.E.	865	KT-542
60 NEW	Reliance	1200	AA-504V
60	Reliance	3600	TEFC
50	G.E.	720	KT-542
50	West.	900	CS
50 NEW	Reliance	1200	TEFC
50	G.E.	1200	KT-536
50 NEW	Reliance	1200	AA-445
50 NEW	Reliance	1800	TEFC
50 NEW	Reliance	1750	2200 V.

SLIP RING MOTORS
3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
400	West.	450	H.F.
200	Cr. Wh.	590	
200	West.	509	CW
150 (3)	West.	1150	CW-873C
150	Triumph	580	
75	Allis Chal.	695	
60	G.E.	570	MTC
60	Burke	1200	EM

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

Nordberg G.E. 875 KW diesel generator set, complete, 257 rpm, 2300 v., 1250 HP, w/crane.
Allis-Chalmers 625 KW turbo-generator, 440 v., condensing, 1500 rpm, panel, exciter.
5—Superior diesel electric generator sets, 100 KW direct current, 120/240 volts.
Locomotive crane, diesel, gas & steam (4).
Locomotives, 7 to 80 tons, diesel, gas, steam.
Whirley portal gantry crane, elec., 40-ton.

H. Y. SMITH CO.
828 N. Broadway — Milwaukee 2, Wis.

BOILERS—TURBINES—ENGINES and AIR COMPRESSORS

Boilers 50-2000 HP; Turbo Gen. 100-6000 KW; St. Eng. Gen. 75-1000 HP. Write for our Free New List of High Grade Used Equipment.

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REFRIGERATION UNIT

275-ton Ingersoll-Rand barometric steam jet refrigeration unit, fully comp. with pumps, motors, and all access. equip. New 1945, used 2 yrs., condition like new. Detail specif. and price will be mailed on request.

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2829 Cedar St. — Phila. 34, Pa.

Most all units still on foundation. Many may be seen operating

TURBO GENERATOR UNITS
Condensing
1563 KVA GE 2300 v. (bleeder)
1560 KVA (2) GE 480 v.
1250 KVA GE 480/240 v. (bleeder)
937 KVA Elliott 2400 v.
750 KVA Allis Chal. 480 v.
625 KVA Elliott 2300 v.
375 KVA GE 480/240 v. (bleeder)

Non-condensing
625 KVA Elliott, 480/240 v.
300 KVA Elliott, 480/240 v.
250 KVA Elliott, 480/240 v.
62 KVA DeLaval, 240/480 v.
20 KVA GE-Terry, 240/480 v.

Turbine Only
535 HP Worthington, 425 lbs.—45# B.P.

DIESEL UNITS
1100 KVA Wghse.-F.M. Model 38D
1000 KVA Elliott-DeLaVerne
312 KVA (2) Wghse.-Worthington CC
250 KVA (2) GE-Buckeye, Model 80
125 KVA General Motors
125 KVA Wghse.-Buckeye, Model E
94 KVA E.M.-Buda—8 DC
75 KVA (2) General Motors
62 KVA Inter. Harves. UD 18
50 KVA GE-Caterpillar
37 KVA General Motors
120 HP belted FM—32E14

GAS ENGINE UNITS
750 KVA Worthington DDG-8
300 KVA El. Mchy.-LeRoi 12 cyl.

BOILERS
600 HP. B&W-Sterling 200#
395 HP. Union type L 300#
309 HP. Comb. Engr. 160#
300 HP. Keeler (Package) 300#
255 HP. (2) Comb. Engr. 200#
3—250 HP. Erie City HRT. 150#

STEAM ENGINE UNITS
312 KVA (3) G-Skinner Uniflow
188 KVA GE-Ames Unif; Vertical

TRANSFORMERS
MOTORS—MG Sets
PUMPS—Compressors

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SQUIRREL CAGE MOTORS

3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	Cont.	NZ-806	2300	1200
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-8961	2300	1760
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AK	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	75	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765

MOTOR GENERATOR SETS

Qu	KW	Make	RPM	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	525	4800/2400
1	2400(3-U)	Whse.	720	600	4800/2400
1	1000	G.E.	514	550	2300
1	1000(3-U)	Whse.	900	250/125	4160/2300
1	500	C.W.	720	250/275	2300/440
2	500	C.W.	720	575	2300/440
1	500(3-U)	Whse.	1200	250	440
1	250	Whse.	1200	125/250	2300
1	200	Whse.	1200	125/250	2300/440
1	200	Ridgway	900	275	2200
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Al.Ch.	2000	125/250	4000/2300
1	100	C.W.	1200	125	440/220
1	100	Delco	1200	125/250	440/220
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	4000/2300
1	75	Star	1200	230	440/220
1	75	Al.Ch.	900	250	2300
1	75	Whse.	900	275	2200

We can furnish any of the above sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt for your requirements.

SLIP RING MOTORS—CONSTANT DUTY

3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	1800	G.E.	MT-498	2300	352
1**	1200	G.E.	MT-26	2200	275
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2300	360
2	500	G.E.	I-16-M	2300	450
1	400	Al.Ch.	ANY	2200	514
2	400	G.E.	MT-412	2200	450
1	300	Al.Ch.	ANY	2200	514
1	250	Al.Ch.	ANY	440	720
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	600
3	150	G.E.	I-13-M	2200	1750
1	125	Whse.	CW-870	2200	900
1	100	F.M.	H20C	440	900
2	100	G.E.	I-15-M	2300	514
1	75	Whse.	CW-7540	440	720
1	60	Whse.	C.W.	440	900
1	50	G.E.	MT-536	2200	1200

With the above we can supply manual or full magnetic control, standard or reversing, also with dynamic braking if required.

MOTOR GENERATOR SETS COMPLETE WITH CONTROLS STILL ON THEIR FOUNDATIONS AVAILABLE FOR IMMEDIATE SHIPMENT

(3) West., (4) G.E. 1,000 KW, 600 VDC Generators, compound, interpole, 514 RPM, 1440 HP., syn. motors, 11,000 v., 3 ph., 60 cy. (Will reconnect for 6,600 v.)

(3) G.E. 1,500 KW, 250 VDC, 514 RPM compound, interpole, polaface windings, 2,100 HP. syn., motors, .8 pf. 13,200 v., 3 ph., 60 cy. (Will reconnect for 6,600 or 4,160 v.)

Priced right for REMOVAL

SYNCHRONOUS MOTORS

3-ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	6000	G.E.	100	2300	90
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
2	1750	G.E.	100	2300	3600
1	1000	El.Mchy.	100	440	1200
1	750	G.E.	80	2300	450
1	250	G.E.	80	2300	514
1	250	El.Mchy.	80	440	400
1	187	G.E.	80	220/440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550	600
1	150	G.E.	80	550	450
3	135	G.E.	80	4000/2200	1200
3	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-189-A	1150
1	300	Whse.		240/300
1	200/250	El.Dy.	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	500/1200
1	200	Whse.	Mill	300/1200
1	180	G.E.	MPC	400
1*	150	C.W.	83-H	890
1***	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
1	90/160	G.E.	MPC	625/1125

All above 230-VDC except where marked ***.
***—Pedestal bearing mill design 525, 600-VDC.
Rev.—designed for mill reversing service.
*—T.E.F.C.

T. B. MAC CABE COMPANY

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3—833 KVA Westinghouse transformers OISC, 1 ph., 2400/4160Y to 480 volt, Type SL, Ser. 2,150,000
3—150 KVA Westinghouse Transformers OISC, 1 ph., 60 cy., 2380 to 460/230/110, Type SK, Ser. #528371, -2, -3
1—200 HP, 600 RPM, GE, Slipring IM, Frame 17, 3/60/220/440
1—100 HP Allis Chalmers, Slipring, Type ARY, BB, 3/60/220/440/900, Frame 826E
3—100 HP, 1800 RPM Westinghouse Sq. Cage, type CS 663C, 3/60/220/440
3—75 HP, Westinghouse Sq cage motors 3/60/220/440/900 Frame 752C Type CS
1—125 HP 600 RPM, EM, Synchronous 3/60/2200 type BRKT
1—200 KW MG set, 125 V. DC, 900 RPM Syn. drive, 3/60/2300 E.M. Factory Set.
2—24x24 Dayton Dowd CB24, 16,500 GPM, 18.5/35 FT. HD., 360/450 RPM

BENSON-WILIMZIG, INC.
Phone GARFIELD 4280
1709 NORTH EIGHTH STREET
ST. LOUIS 6, MISSOURI

SLIP RING MOTORS—3 Ph., 60 Cy.

1	30	G.E.	220	MT	342	690
1	40	G.E.	220	MT	346	690
1	40	**Al.-Chal.	440	B. Brg.		900
1	50	West.	220	CW		1175
1	50	West.	220	CW		1175
1	60	West.	220-440	CW	766A	870
1	75	G.E.	220	MT	456	870
1	100	G.E.	220		16	430
1	*250	C.W.	550	BW	68-CS	1800
1	*100	C.W.	550	BW	68-DS	1800
1	*500	C.W.	550	BW	80-BS	1800
1	500	G.E.	2300		17B	900
1	500	G.E.	2300		17B	900
1	*600	C.W.	550	BW	80-CS	1800
1	600	West.	440	CW	432D15	1800
1	*600	West.	440	CW	432D15	1800

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2—600 HP McIntosh-Seymour, 200 RPM engines direct connected to 512 KVA, 3/60/2300 General Electric Alternators with exciters.

1—675 HP McIntosh-Seymour, 225 RPM engine with 575 KVA, 3/60/2300 V. General Electric Alternators with exciter.

Units may be seen and run at Power Plant Site. Priced to sell immediately—

FAIRBANKS, MORSE & CO.
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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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ALTERNATORS 25 Cycles

Suitable for use as
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SYNCHRONOUS CONDENSERS

3160 kva. 750 rpm.
1700 kva. 750 rpm.
270 kva. 750 rpm.

Excellent condition. Immediate delivery.

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1000 KW 250 VOLT DC

General Electric extraction type turbo-generator unit complete with condenser and switch board. 12 years old. Excellent operating condition. Available for immediate shipment. We are anxious to move this unit—priced accordingly.

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Attn. Paul Newcombe
Rockford, Michigan

AVAILABLE: 1—700 also 450 HP—180 rpm, 4160 volt, 3 phase, 60 cycle UNUSED SYN. MOTOR.
1—1875 KVA G.E. condensing turbine unit. 100 & 150 KW, 440 AC—250 DC M.G. Set.
WANTED: 500 KW 360 or 400 RPM—480/2400 volt horizontal waterwheel generator.

H. BLANE JOHNSON & ASSOC.
Application Engineers
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EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

A A A IRON CO.
Canton & Hawkins Sts., Dallas 1, Texas

BOILERS FOR SALE

Two 250 HP B. & W. Water tube boilers, now in operation under Hartford Inspection at 160 pounds. All pipe, valves, and accessories included with 150 ft. steel stack. Available immediately.

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TRUMANN, ARKANSAS

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7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 3/60/220/440/1800 X-Proof.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. CL. 4758 BUFFALO, N. Y.

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10 to 1000 H.P.

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32 in. inside dia. x 70 ft. high.

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GUARANTEED REBUILT

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Motor and Steam Drive

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200—150—125—100—75 HP Slip Rg. Motors
300 KVA F-M Full Diesel Eng. Gen. Set
150 & 100 HP Scotch Marine Boilers
1500 HP 900 RPM Synchronous Motor
300,000 Gal. Tank on 110' Tower
3600 Sq. Ft. Surface Condenser
30,000 1/0 Trenchlay Cable

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POWER PLANT

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Offering three 4000 KW turbines with all appurtenances.

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DRUM CONTROLLERS—GRIDS—RAILS—BASES—GENERATORS—FREQUENCY CHANGERS—SPECIAL VOLTAGE APPARATUS

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25,000 KVA-20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° T.T. complete with direct connected shaft exciter, switchboard, a 30,000 square foot Westinghouse surface condenser and condensing accessories.

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4160 volts, 200# P.S.I., 600° TT.
3750 KVA Westghse. 2300 volt, 200 PSI.
2500 KVA G.E. Type ATB. Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator **LESS TURBINE.**
2500 KVA Westghse. 2300 volt, 250 PSI.
1563 KVA Allis, 600 volts, 200 PSI.
1000 KVA G.E., 2300 volt, 250 PSI.

Non-condensing—3 phase, 60 cycle

1563 KVA G.E. 600 volt, 250 PSI, 20# gauge back.
940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.
625 KVA G.E. 2300/480 volts, 125-150 PSI 20# back.
375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.
125 KVA G.E., 2300 volts, 150-200 PSI.
125 KVA Westghse, 2400 volts, 150-250 PSI 10# back.

Direct Current

1000 KW G.E., 250 volt, 150 PSI, automatic extraction, condensing.
500 KW (2) Westghse. 3-wire, 250 volt, 285 PSI, condensing.
500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.
300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.
100 KW (2) G.E., 125 volts, 200-275 PSI.
75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.
60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing, exciter sets.

UNAFLOW GENERATOR UNITS

3 Phase, 60 Cycle

625 KVA G.E. 240 volt generator connected 28" x 36" Skinner horizontal engine, 150 PSI complete.
500 KVA G.E. 240 volt generator connected Skinner Vertical engine 150-175 PSI complete.
375 KVA Westghse. 2400/480 volt generator connected Ames Vertical engine, 150 PSI.
175 KVA Westghse. 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.
250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.
20 KW Allis 125 volt generator connected Hill vertical Diesel engine.

UMC UTILITIES MACHINERY CORP.

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STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.
1—795 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.
2—8000 HP Webster Water Heaters.
1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.
6—Steel Coal Bunkers, 80 tons each.
1—30" Wheeler Single Stage Circulating Pump, 30,000 GPM direct connected to 300 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)
1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam turbine.
1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis Steam Turbine, 2-stage with reduction gear, Type SO, 3600 to 1200 RPM.
1—Type 1A-60 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-stage Steam Turbine, 1750 RPM.
1—6" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-stage Steam Turbine, 1800 RPM.
1—Combination Circulating Pump and Condensate Pump driven by 150 HP General Electric single Stage Steam Turbine through a Westinghouse Reduction Gear, 3500 to 700 RPM.
1—2" 2-stage LeCourtney Centrifugal Pump, 200 GPM 650' Head at 3700 RPM direct connected to 53 HP Westinghouse Steam Turbine.
1—3000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 250 RPM, 600 Volts DC with 1—3150 KVA General Electric Transformer, 3 phase, 25 cycle, 6600/13200-445 Volts with starting panel and all instruments.
1—1000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 750 RPM 600 Volts DC with 1—1050 KVA General Electric Transformer, 3 phase, 25 cycle, 13200/445 volts with starting panel and instruments.
1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.
1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 13200/6600 volts.
7—700 KVA Westinghouse Transformers, single phase, 25 cycle, 7620/6600 volts to 13200 volts.
1—Kennecott Pressure Type Industrial Water Filter.
1—30-Ton Electric Traveling Crane—55'5½" Span.

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SPECIAL OFFERING — Immediate Delivery

1—125 H.P. Erie City Economic, 150# working pressure. Complete with stack and condensate return system. New in 1945.
2—150 H.P. D. M. Dillon Scotch Marine Boilers, 165# pressure, A.S.M.E., N. Y. Standard, Oil Fired, further specifications on request.
4—600 H.P. Babcock & Wilcox, Sectional Steel Headers, Straight Tubes. Insured and Operating this year at 200#.
1—600 H.P. Low Head Boiler.
A number of high-pressure boilers up to 600# pressure and 3000 H.P.

TURBO GENERATORS

1—1000 KW, 1—750 KW, 1—500 KW, noncond, 15 lbs. B.P. 3/60/480 V.

We handle Boilers of various sizes and varying pressures; also Turbo-Generators, Diesels, transformers, switchgear, compressor etc.
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Erie City Economics—125, 170, and 200 H.P.
Fire Box Boilers—165 H.P.
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2 New Frederick Stokers—2500 lbs. of coal/hr.

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Used Equipment—Good Condition

Inspection Invited

EVAPORATING & CRYSTALLIZING PLANT—7 Swenson Calandria type Evaporators and one Vacuum Crystallizer, two stage. Complete plant with pumps, etc., on steel structure.

POWER PLANT—3—500 HP B & W Sterling type Boilers, complete aux. equip. Also 2 Waste Heat Boilers, same type. 1250 KVA 440 V. Generator direct connected G.E. Steam Turbine, switch board and aux. equip. Also steam driven C.P. Air Compressor size 12" x 14" x 11".

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NEW TRANSFORMERS OIL COOLED AIR COOLED PHASE CHANGES

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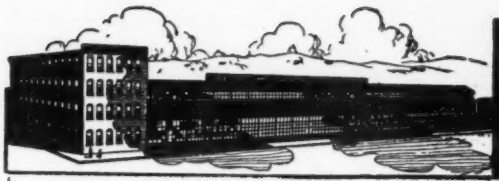

GLOW ELECTRIC CO.

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PHONE MAIN 3024

MEMBERS OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	6600	Westinghouse
350	3600	2200	Westinghouse
300	900	440	G.E.
200	480	2200	G.E.--I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	1200	440	West.-CS
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
60	1200	440	Westgh. CS
50	1800	220	Triumph
50	720	2200	Westinghouse
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.
30	720	220	G.E.
30	514	440	Stanley
25	3600	220/440	L-A
25	1800	220	L-A-HD
25	1200	220	Century
25	900	440	G.E.
25	720	220	Westinghouse
25	600	440	G.E.
20	3600	440	A-C
20	1800	220/440	G.E.
20	1800	220/440	G.E.
20*	1800	220/440	Wesche
20	900	440	A-C
20	600	220	G.E.
15	3600	220	G.E.
15	1800	220/440	G.E.
15	1200	220	Imperial
15	900	220	Howell
15	720	220/440	A-C
10	3600	220	R. & M.
10	1800	220	Westinghouse
10	1200	220	A-C

* New Motors

MULTI-SPEED MOTORS 3 PHASE, 60 CYCLE

HP	RPM	VOLTS	DESCRIPTION
50-12½	960/450	2200	G.E., KT-356
40-20	1200/600	440	Westgh., CS-445
25-12½	1800/900	220	R&M, L-640
20	1800/1200/ 900/600	440	Century, SCN-504Y
20-10	1800/900	220	Century, SCN-27
15-10*	1800/1200	440	Westgh., CS-365
15	1800/900	220	R&M
15-7½*	1800/900	220	Wagner, 364
15	900/450	440	Reliance, B-405 high torque, high slip

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-CW
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	1200	440	Westgh.-CW
300	720	2200	Al. Ch.
300	514	440	Al. Ch. 3 Brg.
250	600	2200	G.E.-117B
250	450	2200	C.-W
250	450	2200	G.E.-I-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	West.-CW
200	600	440	G.E.-IM
200	514	440	West.-CW
150	1800	440	G.E.-MT
150	720	2200	Al. Ch.
120	900	550	Ideal
100	720	440	Al. Ch.
100	400	440	West. Elec. (GE)

* New

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
800	500	West., 3 unit	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
600	230	Westgh. (2-300KW Gen.)	1200	1200	2300
600	250	G.E.	900	900	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.-Westgh.	300	1200	440
100	250	Westgh.	147	1200	4300
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440
12½	230	Westgh.	19½	1800	220
10	250	Westgh.	15	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	HP	A.C. END VOLTS	DESCR.
7500/3750	6/12	270	Munning	60	440	West. CS Sq. Cage
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	200	440	WH Sync.
1500	3 to 40	600	HVW	100	440	HVWSyn.
1500/750	6/12	1200	Munning Loeb	15	440	GE— 1 Cage
1000	60	1200	Century	100	440	Century Cage
1000	20	1200	Star. 1 Brg.	—	—	—
1000	6	1200	Wagner	—	—	—
630	11	900	Westgh.	15	440	W.H. BB.
600	50	900	E-M	40	440	A-C
600	30	1200	W-E	30	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6	G.E.	Rectifier	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

1—125 KW 400 RPM 187½ HP Buckeye Diesel Generator Set with all accessories.
1—225 HP Buckeye Diesel 400 RPM Belted Unit

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- For every industrial and power application.
- Special constructions. Odd lengths.
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- Cut to length. Reasonably priced.

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2—4000 KW, 2300 V., 150 #Cond.
1—3500 KW, 4000 V., 150# Cond.
1—4000 KW 2300 V., 400# Cond.
1—3000 KW 13,200 V., 425# Extr. 170# Non-Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# Extr.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 4160 V., N.C. 1949
1— 500 KW, 4160 200# N.C.
2—1000 KW, 480 V., 180# Cond.
1— 750 KW Consisting of
1—500 KW, 550 V., AC
1—250 KW, 250 V., DC
Non-Cond. 150#

DIESEL GENERATORS

1—1000 KVA, 2400 V.
1— 700 KW, 480 V.
3— 540 KW, 460 V.
1— 437 KW, 480 V.
1— 200 KW, 480 V.

FIRE PUMP

1—New 1000 G.P. Turbine Driven

BOILERS

3—50,000# pr hr. 275# (1949)
1— 850 H.P. 250#
1— 450 H.P. 225# 1942
1— 400 H.P. 200# 1941
2— 250 H.P. 200# 1940

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American Rebuilts
Are Best

AMERICAN AIR COMPRESSOR CORP.
Dell Ave., & 47th North Bergen, N. J.

SLIP RING MOTORS
3 phase, 60 cycle

HP	Make	Speed	Type	Voltage
4-3500	GE	120	IM	2300
200	Whse.	600	CW	220/440
150	GE	600	I	2200
150	Whse.	1200	HP	2300/4000
100	Whse.	690	CCL	220
75	GE	900	MT	440
75	Whse.	600	CCL	220
75	GE	700	IM	220
70	English Elec.	1200	Drip proof	440
50	Al.-Ch.	1800	AR V	440
2-40	GE	1200	IM	220

SQUIRREL CAGE MOTORS
3 phase, 60 cycle

HP	Make	Speed	Type	Voltage
100	Wagner	1200	CI	220/440
75	E-M	500	IC	440
2-60	Howell	1200	TEFC	220/440
60	GE	750	KT	440
60	GE	690	I	440
50	GE	1800	K	220/440

HP	Make	Speed	Type	Voltage
10	Al.-Ch.	1200	ARZZ	220/440
30	L-A	900	JEX	220/440
2-30	Whse.	1200	CS	440
2-20	F-M	1800	QLSC	220/440

SYNCHRONOUS MOTOR

115	E-M	600	open	220

VARIABLE SPEED MOTORS

4-3	GE	1600/600	BTA	220

VERTICAL GEAR HEAD

17-3	GE	246	TEFC	220/440

STEAM TURBINE

1—350 HP, 500 RPM Westinghouse, turbine with reducer, type C-25, output speed 1000 RPM, 150# steam, 20# exhaust, with Woodward governor.

WM. KECK'S SONS

Electric Motor & Engineering Service

201 N. Bluff Street **Joliet, Illinois**

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (2)	2200	G.E.	900
500	2200	G.E.	450
450	440/220	Whse.	514
350	2200/440	G.E.	450
300	2200	G.E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	2200/550	G.E.	450
250	550/440	G.E.	1200
250	440	G.E.	600
200	440	G.E.	450
188	4000/2200	G.E.	1800
150	440/220	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
145	4000/2300	G.E.	1800
125	2200/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/400	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Syn.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1000 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37000 V., G.E., Type FHKO-236 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal.	AR	1800
200	2200	G.E.	K	200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
150	440	Multi sp.	KT	1800/600
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 v., G.E.
3— 75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

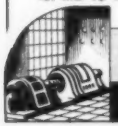
HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230 (2)	Whse.	SK	850
125	230	Whse.	SK	350/1050
100	230	El. Dyn.	30-3	475/1250
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—250 kw, 1200 rpm, 250 V., Whse., conn. to 375 HP, 1200 rpm, 2200 V., syn.
1—175 kw, 1200 rpm, 230 V., G.E., conn. to 250 kva, 1200 rpm., 2200/440 V., syn.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/400 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage.

TRANSFORMERS 60 CY.

3—333 kva, G.E., 13,200—2300 V.
1—300 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
3—250 kva, G.E., 2400-480 volts
1—250 kva, Whse., 11,000/22,000—2300 V.
3—200 kva, Whse., 2400—240/120 V.
1—150 kva, Whse., SK, 13200-125/215 v., 3 ph.
3—150 kva, Al. Chal., 2400-240/120 V.
3—150 kva, Whse., 2400-240/480 V.
3—100 kva, Whse., 2400-240/480 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4156—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
6— 50 kva., G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/220 V., dry



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2—500 H.P. 450 Lb. Walsh-Widener Sectional Header Cross Drum Water Tube Boilers. Complete with Superheaters, Boiler Feed Pumps, and all Miscellaneous Equipment. Built in 1928.

1—400 H.P. Keeler C.D Integral Type Water-tube Boiler with complete Todd Oil Burner Installation. Design Pressure 160#. Built 1940.

2—250 H.P. Erie City 3 Drum Low Head Boilers, 1942, 200 Lb. Working Pressure, Peabody Burners, Brooks Control quipment, Pratt-Daniel Stack on each Boiler Pumps, Heater, and Piping.

1—200 H.P. Union Iron Works, 200#, Universal Economic type.

1—600 H.P. B.&W. Sect. Header Boiler, 200#.

1—150 H.P. Bros 150# w.p., 3 drum, Bent tube, self contained, steel encased, brick lined. 9000# steam per hour.

Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.

1—500 H.P. Cleaver Brooks Package Boiler, 150 Lbs. #6 Oil, 1947.

A Number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.

2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating

Combustion Engrg., Spreader Stoker complete with fan & Hogan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.

1—6 Cylinder Enterprise Diesel 800 H.P. direct connected to 1000 K.V.A., 3 ph., 60 cyl. 2400 V. Elliot Generator complete with all aux. Unit built 1948, 1400 hrs. use only.

1—750 K.W. and 1—500 K.W. DC 240 V Generators dir. conn. to 2—Westinghouse non.-cond. Turbines—3600 r.p.m. reduced to 900 r.p.m. on generators. Includes switch-boards.

3—B.&W. Type FF Integral Boilers, 16,000# each, 160# w.p. 2 in one plant. Complete with all equipment and stoker fired. 1 in another plant complete with all equipment, stoker fired. Built 1946.

A complete plant consisting of 2 Keeler C.P. Boilers complete with Detroit Roto-Stoker, all auxiliaries and piping. Built 1942. Boiler will move without disturbing pressure parts. 160# w.p., 21000# per hour each.

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1—1250 KVA Nordberg 2300 V.
1— 400 KW Enterprise 2400 V.
1— 190 KVA Baldwin 440 V.
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8— 100 KW Superior 120/240 V.

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1—144 KW vert. alt. G.E. 3-60-240V 120 RPM. Smith turb. for 9-10' head $2500.
1—240 KVA vert. unit 3-60-2300V 225 rpm. Ex. on top Leffel 27" turb. 17' head.
1—250 KW vert. unit 3-60-250V 600 RPM Smith adj. blade turb. Ex. on top 29' head.

WM. C. MOULTON ASSOC., Monson, Mass.

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AVAILABLE IMMEDIATELY

1—6250 kva 5000 kw 3600 rpm Allis-Chalmers 200 lbs. 100° SH condensing. Will operate 275 lbs. 615° TT without change. Generator 3/60/11500 can be changed to 2400/4160 V. Complete auxiliaries—can be operated for inspection. Checked by factory engineer in September 1951—no repairs required.

1—1875 kva 1500 kw 3600 rpm General Electric 150 lbs. 0° SH condensing. Generator 3/60/2300.

1—1567 kva 1250 kw 3600 rpm Allis-Chalmers 140 lbs. condensing. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.

1—1250 kva 1000 kw 3600 rpm Westinghouse 185 lbs. 100° SH condensing. 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1—937 kva 750 kw 3600 rpm General Electric 150 lbs. condensing. Generator 3/60/2300.

1—625 kva 500 kw DeLaval geared 5000/900 rpm 150 lbs. condensing. Generator 3/60/2300. Can operate 275 kw 10 lbs. BP without change.

1—187½ kva 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100° SH non-condensing. Generator 3/60/240.

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BATTERY CHARGER
2—400 amp 42 volts Hirtner M-G set 3/60/220-440 with complete D.C. control and motor starter.

COMPENSATORS, A.C. AUTOMATIC
75 hp 3/60/2300 Cutler Hammer Bul. 9622 w/current limit, fuses. New
125 hp 3/60/2200 G.E. CR7651-H1A.

COMPENSATOR, A.C. MANUAL
100 hp 3/60/2200 Westinghouse Type A

CONDENSERS
2—725 sq. ft. C. H. Wheeler 2 pass surface. New

COMPRESSORS, AIR
1000 CFM @ 225 rpm CP 2 stage 20"x12"x14" short center belt drive.

DIESEL GENERATORS
250 kw 400 rpm 3/60/220-440-2200 Superior YLO

ENGINE GENERATORS
2—65 kva 327 rpm 3/60/220 Engberg 9x10 vertical 175 lbs. non-condensing.

GASOLINE ENGINE GENERATORS
50 kw 1800 rpm 3/60/220 Waukesha-Bardco on wheels.

GENERATORS, A.C.
375 kva 225 rpm 3/60/220 Allis-Chalmers engine type
250 kw 1800 rpm 3/60/2200 Westinghouse ped. brgs.
200 kw 720 rpm 3/60 any voltage GE ped. brgs.

GENERATORS, D.C.
75 kw 1200 rpm 125 V. GE single brg.
20 kw 1200 rpm 125 V. GE CDM

MOTORS, SLIP RING
350 hp 360 rpm 3/60/2300 GE Type IM
200 hp 1800 rpm 3/60/2200 GE Type IE 13B
200 hp 1800 rpm 3/60/440 GE Type IM
100 hp 900 rpm 3/60/440 GE Type MTC5346
75 hp 1800 rpm 3/60/2200 Westinghouse C.W.
2— 75 hp 720 rpm 3/60/2200 Westinghouse HF
50 hp 720 rpm 3/60/2200 GE Type MT552
50 hp 900 rpm 3/60/2200 GE Type IM

MOTORS, SQUIRREL CAGE
125 hp 3600 rpm 3/60/2200 GE Type FT
60 hp 1800 rpm 3/60/220-443 F-M Type H
50 hp 720 rpm 3/60/2200 GE Type KT546

MOTORS, SYNCHRONOUS
400 hp 1800 rpm 3/60/2200 Westinghouse ped. brgs.
290 hp 720 rpm 3/60 any V. GE Type ATI ped. brgs.

MOTOR-GENERATOR SETS
1000 kw 600 V. 514 rpm Westinghouse 1440 hp any voltage syn. motor

OIL CIRCUIT BREAKERS
600 amp. 15000 V. West. FO221 o/d solenoid oper.
600 amps. 15000 V. Conduit Oil o/d solenoid oper.
9—1200 amp 15 KV Westinghouse CO-11 De-ion Grid 500,000 KVA 125 v. D.C. solenoid indoor
1—2000 amp 15 KV Westinghouse CO-11 De-ion Grid 500,000 KVA 125 v. D.C. solenoid indoor
1—480 amp 73 KV Gen Elec FK0238 outdoor

PUMPS, BOILER FEED
750 gpm 450 lbs. 3600 rpm Goulds 3360 4"—4 stage
475 gpm 750 lbs. 3600 rpm Goulds 3360 3"—6 stage
2—150 gpm 230 lbs. 2750 rpm Frederick steam turbine

TRANSFORMERS, 60 CYCLES
2—1000 kva 13800/2300 V. 1 Ph. GE Type H Form VDDJ
3—75 kva 2400-4160/240-480 V. 1 Ph. GE Type H Form KF
3—37½ kva 2400-4160/120-240 V. 1 Ph. GE Type H Form K
131—10 kva 2400-4160/120-240 V. 1 Ph. Various Makes—All modern
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Complete plant, 360 HP. Marine Diesel with 312 KVA—Generator, 60 cycle 2300 Volts.

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Gardner 10 x 8, 20 HP. GE Motor, with controls.

Gardner 12 x 10, 30 HP. GE Motor, with controls.

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American Well Works Tanden, 500 GPM—at 60#, 30 HP. GE Motor with controls.

All the above equipment are in operating condition and have been used very little. Buyer to remove any or all items purchased within 30 days from date of sale.

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1—75 KVA—2400 V, 3 phase, 60 cycle Uniflow Engine Generator with exciter
1—Panel Board with circuit breaker and voltage regulator
1—250 HP Heine Boiler 180 lb. design
1—Webster open type feed water heater
1—Miscellaneous included valves, pipe and fittings
1—Feed Pump

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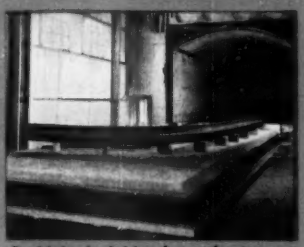
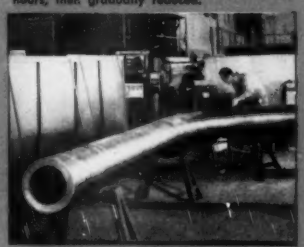
Manufacture of this main steam piping began at Pennsylvania Forge Corporation as 20-ton alloy-steel ingots (2¼% chrome, 1% moly steel). Four days' forging changed the ingots into solid bars 30 ft. long, with outside diameter of 15½ in. Boring, turning, sizing and finishing followed.

Bending furnace raises pipe temperature to 2000°F in 3 hours, 40 minutes. Thermocouples and pyrometer measure pipe temperature.

Skilled team completes bend in six minutes. Inside surface temperature dropped about 100°F.



Bend being loaded into furnace for stress relieving. Heat maintained at 1425°F for 4½ hours, then gradually reduced.



Ultrasonic inspection of weld after cleaning of pipe shows maximum thinning in bend of 1/16 inch.

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